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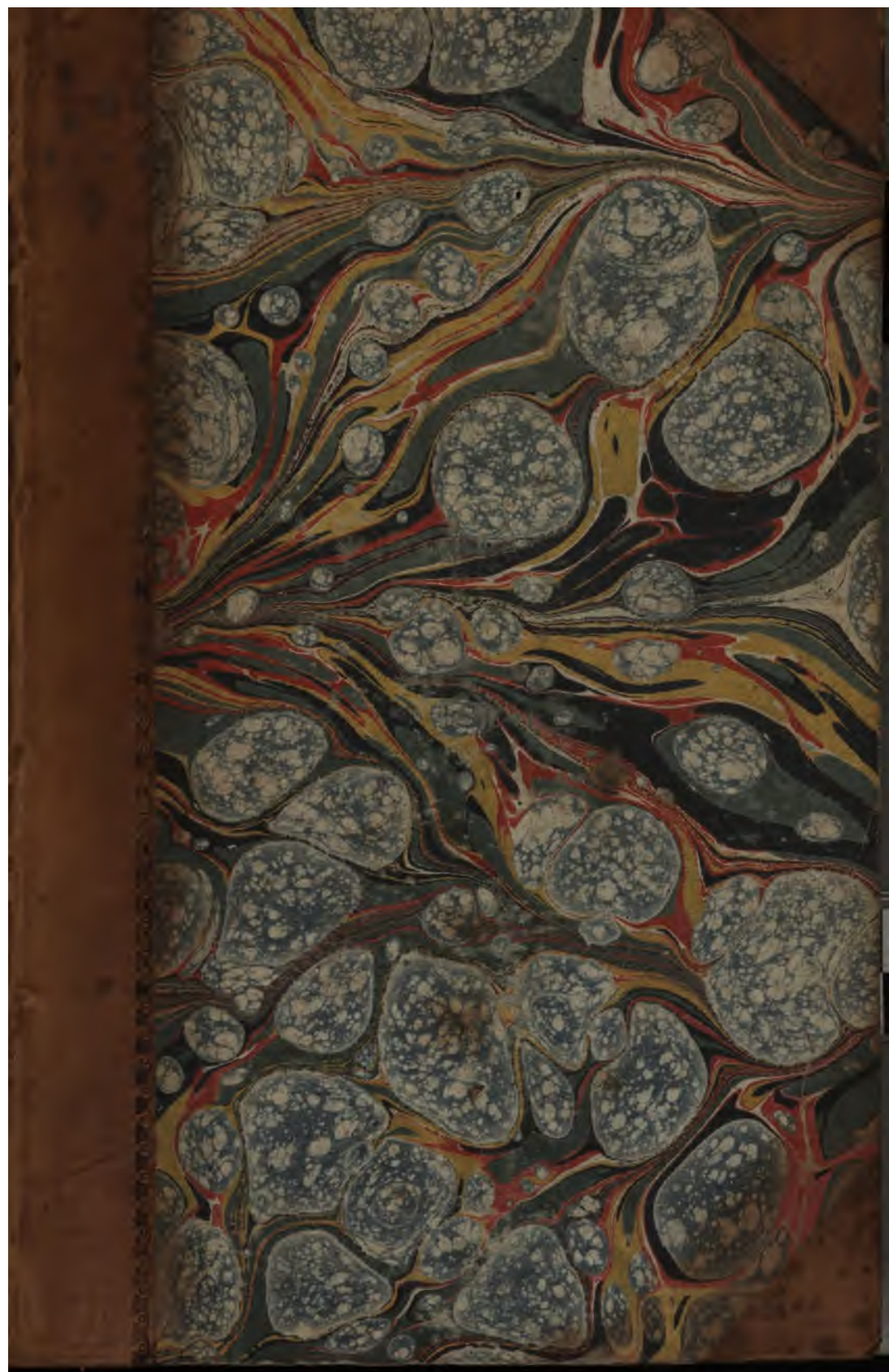
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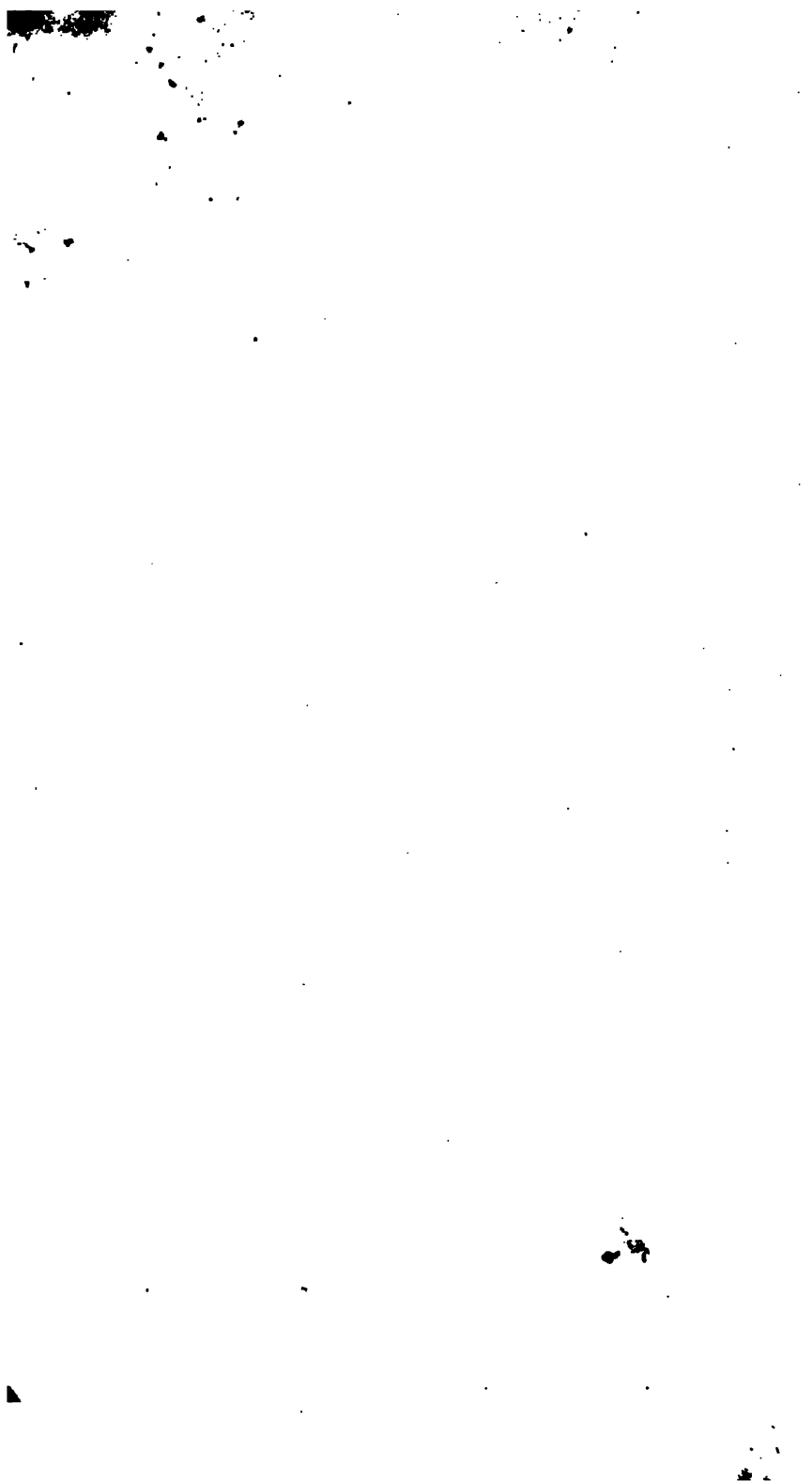
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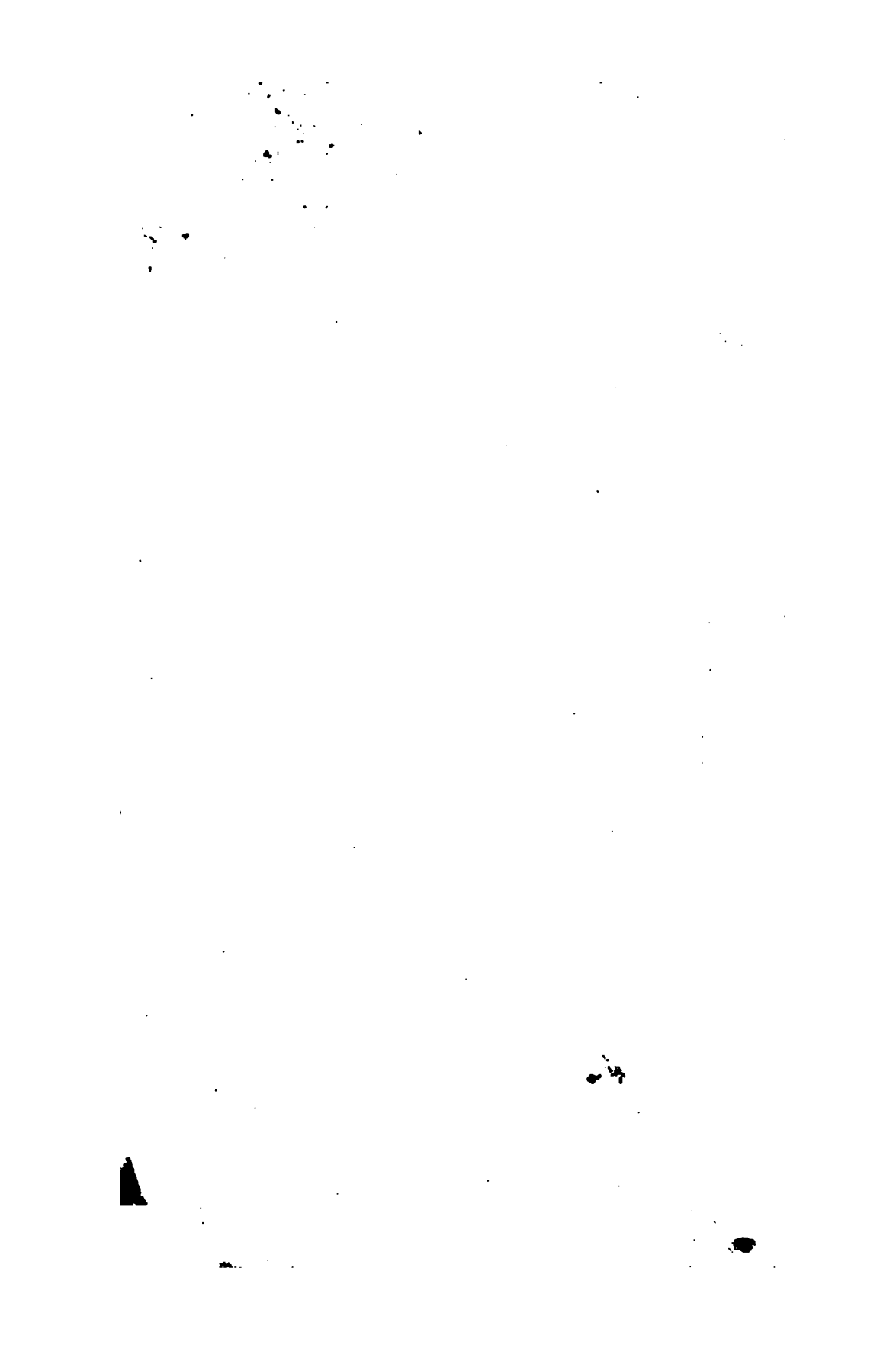


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**GILL'S  
TECHNOLOGICAL REPOSITORY;**

OR,

**DISCOVERIES AND IMPROVEMENTS**

IN THE

**Useful Arts,**

BEING A CONTINUATION OF HIS TECHNICAL REPOSITORY.



By **THOMAS GILL**, *Patent-Agent*,

AND DEMONSTRATOR IN TECHNOLOGY, ON THE APPLICATION OF  
SCIENCE TO THE USEFUL ARTS AND MANUFACTURES;

UPWARDS OF TWENTY YEARS A CHAIRMAN OF THE COMMITTEE OF MECHANICS IN THE  
SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES,

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AND AGRICULTURAL SOCIETIES OF MUNICH.

**VOL. IV.**

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**1829.**



# GILL'S TECHNOLOGICAL REPOSITORY.

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## I.—On the Microscope. By the EDITOR.

WITH A PLATE.

(Continued from Vol. III., page 327.)

*On the Wheel-Animalcula, in continuation.*—Since the publication of our last number, we have been frequently, at times, engaged in following up our discovery of the eyes of this animalcula, as published in page 322, with a figure of the snout or tube containing the eyes; since then, we have discovered minute fibrillæ around the end of that tube, and whether its mouth may not also be there, we cannot be certain.

We now add in plate I. other figures, showing the eyes in various situations, in order to leave no doubt upon this interesting discovery. In fig. 1 they are shown as in our former figure, at the end of the snout; in fig. 2, as placed between the wheels; and in figs. 3 and 4, as thrown backwards. In several of these figures, another slender tube is also shown, posited at the back of the snout which contains the eyes, and which has frequently been represented in works treating upon this singular animalcula, such as Baker's, and others; and generally in the side views of it. In fig. 3 is also shown an oval body, which frequently changes its place in the body of the animalcula, and, no doubt, is one of its eggs, of which we have seen many affixed upon the leaves of the *lemna*, and other aquatic plants, as well also as upon the sides of the glass vessels in which we have kept these truly interesting microscopic objects; sometimes we have even seen the

young ones moving in the eggs; and very frequently we find the shells of them remaining attached to the leaves, with one end of them open; and, indeed, several had the broken piece remaining attached to them, as left by the animalcula on its escaping therefrom, and as we have represented it in fig. 5; but, in general, we find them without that part. The heads, and parts of the bodies, of the wheel-animalcula, are only shown in our present plate; as the other parts were hidden under the leaves to which they adhered.

Baker suspected that the wheel-animalcula had eyes, although he failed in discovering them. In his work, "Employment for the Microscope," is a letter addressed to Martin Folkes, Esq., President of the Royal Society, dated January 16, 1744-5, and containing a description of this animal; towards the end of which letter, he says:—"It has constantly been my endeavour to discover the eyes of this creature, but I have never been able to discern that it has any. And yet, when one beholds it swimming along with great swiftness, turning its head on every side, and seemingly pursuing its prey, avoiding any matters in the water that would obstruct its passage, and directing its course with as much seeming care, choice, and conduct, as animals that have eyes do, one can hardly think it destitute of sight.

"I would industriously avoid giving way to fancy in cases of this nature, but must acknowledge my suspecting that it has eyes somewhere within its wheels: and my reasons for this suspicion are, its blundering, irregular, and slow motions, while it appears in the form of a maggot before its wheels are put out, and the regularity, swiftness, and steady direction of its motions afterwards: whereto I might add, that when it swims along its wheels are always out. Besides, all the creatures we know, that move themselves from place to place with swiftness, either by running, flight, or swimming, are remarkable for their keenness of sight; and, indeed, it seems probable that the same rule

may hold through all the animal creation ; for, as the gifts of Providence are ever suited to the exigencies of its creatures, and contrived in the best manner for their preservation, we can scarcely imagine that swiftness is bestowed on any without the additional blessing of sight to direct its course ; since the former, without the latter, must inevitably precipitate the creature into continual danger of destruction. This makes me suppose it may possibly have organs of sight somewhere about the wheels : nor is there any thing more extraordinary in that than in the eyes of snails, which are generally allowed to be placed at the extremities of their horns, and, consequently, must be thrust out and drawn in with them."

We see by this extract how very near Baker was to the making of this discovery, and yet he missed it ! The wheels are used by the wheel-animalcula to propel it through the water much in the same manner as in the case of the wheels of steam-boats ; as well also to produce a current of water running towards it when stationary.

Mr. T. Carpenter, with all his accuracy of observation, had also overlooked the eyes of the wheel-animalcula, and never saw them until they were recently pointed out to him by the Editor. He is now, however, fully convinced of their existence. They form a valuable *test object*, and can only be seen in excellent microscopes.

It is really curious to see this animalcula, after fixing itself, first thrust out its snout and eyes to see if the coast be clear, and then put out its wheels and retract its eyes to either of the several positions shown in our figures. Many of them also herd together, and thus employ their joint powers in producing a more powerful current than either of them singly could do, and thereby attract and draw their prey towards them in much larger quantities than they could otherwise accomplish.

They do not readily quit the leaves they have affixed themselves to, and thus we have been enabled to place them for three successive days under the microscope, con-

stantly finding them in the very same places upon the leaves as on the first day of observing them; and which, indeed, has proved a very great convenience to us.

*On the Eggs of the Animalculæ, shown in fig. 4, of plate IX., vol. III.*—In fig. 6, of plate I., we have given a representation of one of these eggs magnified on the same scale as that of the egg of the wheel-animalculæ shown at fig. 5: having frequently seen from one to three of them adhering by slender filaments to the body of the parent animalculæ; and which, although as large as the wheel-animalculæ, is nevertheless produced from a much smaller egg.

*On a Green Animalculæ, with three spiral webs around its body.*—On the thirteenth day of the last month, and whilst engaged in viewing the wheel-animalculæ under the power of a single lens, the twentieth of an inch focus, the Editor was highly gratified with a perfect sight of this most curious animalculæ, and of the singular manner in which it progressed slowly through the water, and which he afterwards exhibited to a friend who was upon a visit to him.

In plate I. fig. 7, is a top view of it; and fig. 8, an end view; in which the arrangement of the three spiral webs around its body, like the feathering of an arrow, are clearly shown. It moved through the water by turning around its body as an axis, in the direction of the dart shown in fig. 8, with an uniform, steady, screw-like motion; and could move in any direction at pleasure with its head forwards, its tail ending in a very fine and slender point.

No doubt this animalculæ has been often seen before; but, possibly, not the extraordinary manner in which it moves through the water; at least, the Editor never before enjoyed the sight thereof.

This animalculæ was found in the New-River water, in which some *chara* and the *reticular conferva*, brought by Mr. J. Gray, from Lee, in Kent, were kept; and which water, contained in a cylindrical glass jar, six inches high,

and three in diameter, affords an endless succession of microscopic objects; not only on its sides to which the animalcula frequently adhere, but especially at its bottom, where, amongst the partly decomposed vegetable remains, numerous and greatly varied species of them are constantly to be found; as well, also, as adhering to the leaves which float upon the top of the water; and where, indeed, the Editor seldom fails to find clusters of wheel-animalculæ arranged in a most convenient manner for viewing under the microscope, when the leaves are placed in one of his shallow cisterns, described in the last volume, and covered with a thin plate of glass, with water between and around them.

*The Flesh-coloured Polypes* also thrive in the same jar, and increase their numbers; their curious methods of catching their prey being readily seen with a lens of low magnifying powers, when they have affixed themselves to the inside, top, or bottom of the jar. The Editor was indebted to his friend, Mr. T. Carpenter, for his first supply of these. He had, indeed, before repeatedly collected and endeavoured to keep such alive, but without success; although the smaller *green polypes* lived a considerable time with him under similar treatment.

*On the apparatus employed by the Flea.*—Mr. T. Carpenter having now placed several dissections of this apparatus between thinner slips of glass, we are enabled to bring them under the power of a single lens, the twentieth part of an inch in focus, belonging to our Varley's microscope, and to afford a delineation thereof.

In plate I. fig. 9 exhibits part of the head of a flea; *a a* are the two antennæ, or feelers; *b* the sucking tube; *o c* two piercers; and *d d* two knives, with their blades and strong backs to them.

The piercers are serrated along the inner parts of their edges, as shown in our figures. Dr. Hooke, in his *Micrographia*, considers what we term knives, as the blades of a

pair of scissars. However, it must be allowed that they are excellently adapted for cutting, whatever they may be termed.

*On Animalculæ which inhabit the shells of the eggs of the Wheel-Animalculæ.*—Several of these shells contained animalculæ of a pear-shaped figure, and resembling that shown in fig. 10 of plate I., which occasionally protruded and withdrew the curved and radiated appendage there shown; and it was capable of producing, by means not apparent, a current that drew more minute animalculæ than itself, within its reach.

*On the Weevil which destroys corn.*—By the kind assistance of Mr. T. Carpenter, we are enabled to gratify our readers with a magnified representation of one of these destructive insects, in illustration of the remarks he has made upon them in one of his interesting articles contained in the present number.

In plate I. fig. 11 is a top view of a weevil, in which its proboscis or snout, with the end of which he perforates the skin of the grain, is shown; and also the antennæ attached to it. It is in the opening thus made that the insect deposits its egg, as described by Mr. Carpenter.

*On the head, proboscis, and jaws of the Nut-Weevil.*—In fig. 12 of plate I., we have given a magnified front-view of one of these insects, drawn from one in Mr. T. Carpenter's possession, and under his opaque microscope. The jaws with which it perforates the soft shell of the nut, are clearly seen at the end of its proboscis. The other particulars relating to it will be found in Mr. Carpenter's article in the present number.

*On the head, eyes, and jaws of the Larva of the Cicendela Campestris.*—In plate I. fig. 13 is a magnified view of the head of this insect, drawn from the object itself, under the power of Mr. T. Carpenter's opaque microscope. Its six eyes are distinctly shown, as also its powerful jaws or fangs, with the two strong teeth near their bases; and

likewise its palpi or feelers. The curious mode in which it seizes its prey, will be found in the second article by Mr. Carpenter in our present number.

*On the head, jaws, &c., of the Cicendela Campestris.*—Fig. 14 of plate I. exhibits a magnified view of the head, thorax, &c., of this beautiful though destructive insect, as seen in Mr. T. Carpenter's opaque microscope:—*a a* are its two maxillæ, furnished with strong bristles and teeth standing at right-angles to them; *b b* its ocellæ, or two compound eyes; *c c* parts of its long antennæ; *d d* its two powerful mandibles, or jaws; *e e* its labial palpi, or feelers; and *f f* the two pairs of maxillary palpi, or feelers. Interesting particulars of this insect will also be found in the article last mentioned.

*On viewing the scales or feathers of Moths and Butterflies as opaque objects.*—Mr. T. Carpenter, availing himself of the information, given in page 263, of our last volume, of Professor Amici having provided, amongst the apparatus of his reflecting microscope, a slip of glass, having a flat, circular, black, and polished piece of glass, about three-eighths of an inch in diameter, cemented upon the middle of it, to receive opaque objects; has fitted up several such, with the additional precaution of likewise cementing a piece of card underneath the glass slip, exactly the size of the black glass, to render it entirely opaque. Upon these black glasses he had placed, ready for the Editor's inspection, under his microscope, the last time he gratified him with a sight thereof, different kinds of scales or feathers taken up from the wings of various moths and butterflies, by merely breathing upon the black glasses and applying the wings to them, when they readily took up a series of the scales, beautifully arranged in their natural manner, and as they were posited upon the wings, but with their undersides uppermost, of course. These formed highly interesting opaque objects when illuminated in his superior manner; and, in order to view their uppersides, he had only to moisten another black glass in a similar man-

ner, and to apply it upon one of those which were already covered with scales ; when it, in its turn, took them up, and with their sides reversed, of course. The objects might, indeed, have been permanently affixed upon the black glasses by previously coating them with gum-water ; but then something of the polish of the surfaces of the black glasses would have been lost ; and it was very easy to replenish them at any time from the damaged wings of insects in his possession.

The Editor finds that a small black wafer affixed *underneath* the middle of any slip of glass, is sufficient to blacken and render it opaque ; and any scales, feathers, &c., may then be applied in the first-mentioned manner upon the polished surface of the glass above the wafer, and afford equally beautiful opaque objects as if the black glasses were employed. So also, a small circular spot of black sealing-wax applied underneath the glass, in a similar position, by first heating the glass until it will melt the wax, has a similar effect.

*On a Spider with ten eyes.*—Mr. T. Carpenter showed the Editor lately, under his opaque microscope, a black spider from Africa, with no less than *ten eyes* ! Of these, four were placed in a square cluster in the front of its head ; two on each side of the front, affixed in pairs, on raised appendages ; and two large ones were placed behind the head. A wonderful provision, indeed, both for its defence and to enable it to view and seize its prey !

(To be continued.)

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## II.—*On Professor Amici's Reflecting and Refracting Microscopes* \*.

THIS learned philosopher, of Modena, having observed that even the best microscopes were not exempt from de-

\* From the *Dictionnaire Technologique*, 1828.

fects; and that the uneasy position of the observer, in viewing the objects, when standing above them in a vertical position, no longer left it in his power to continue with convenience a long series of observations; thought of placing the body of the microscope in a horizontal position, and also of modifying the apparatus so as to improve its effects; and the observer is thus enabled, in using these microscopes, to pursue his labours with great facility. M. Amici has invented two different microscopes, a catadioptric, or reflecting one, and a dioptric, or refracting one; which we shall now describe.

The apparatus, such as the illuminating mirror, the stage, the rack, &c., are nearly the same as in other microscopes, but with the necessary alterations made therein to enable us to place the body of the microscope in a horizontal position. The farther end of the body of the reflecting microscope is so formed as to enable us to bring the object, when placed below it, conveniently near to it; a small speculum *c*, shown in dotted lines, in fig. 15, of plate I., inclined at an angle of  $45^{\circ}$ , reflects the image of the object, which enters an orifice made in the side of the tube; and the bent rays are again reflected by a concave elliptical speculum *d*, placed near the end of the small tube, and of one or two inches focus, or less. This concave speculum receives the rays proceeding from the object, which is situated in its focus (that is, supposing it to be placed below the plane speculum *c*, at the same distance), and reflects them towards the other end of the microscope on a magnified scale. A Ramsden's astronomical eye-piece, composed of the two plano-convex lenses, shown by dotted lines at *e* and *f*, and which is placed at that end of the microscope next to the eye of the observer, serves to amplify the image of the object which is reflected at *i*; where also is placed a diaphragm, and likewise stretched spider's threads to serve as a micrometer, whereby to measure or compare the sizes of objects. The body of the instrument is from six to eight inches long. The fol-

lowing is a list in detail of the change of speculums usually employed; the tubes containing them being to be screwed successively into the farther end of the body of the microscope, according to the magnifying power required:—

Foci of the speculums - 1,5 . . 1 . . 0,6 . . . 0,3 inches.

Their diameters - - - 0,6 . . 0,3 . . 0,3 . . . 0,2 inches.

The great difficulty of making the elliptic speculums for these reflecting microscopes, will, however, considerably lessen their employment; and the invention of achromatic lenses will therefore determine philosophers to give the preference to refracting microscopes. The following is M. Amici's:—

The tube of this instrument is also placed in a horizontal position, and is formed of the two tubes  $h'g$  and  $h'q$  (see fig. 16 of plate I.), the innermost of which is made to draw out. At  $h$ , is an astronomical eye-piece, composed of the two plano-convex lenses  $m$  and  $n$ , separated by a diaphragm, placed in the focus at  $i$ . We can draw out the inner tube  $h'g$  to the proper degree; and according to the magnifying power we would obtain. A large circular disc or plate of blackened sheet-iron, or card, and which has a round hole in its centre, is placed at  $A A$ , upon the tube of the instrument next to the eye of the observer, and which serves to cut off all access of foreign light; and, consequently, renders it unnecessary to close that eye, as usual, which is not employed in viewing the magnified objects.

Near the farther end of the body of the instrument, and below it, is placed a small screwed tube, upon which may be affixed the achromatic object-glasses; and which are of different foci, according to the degree of magnifying power required. The image of any object, placed a little before the focus of the object-glass, is thrown vertically from below upon a rectangular prism of glass  $D$  (shown by dotted lines), which performs the office of a mirror, and reflects the image horizontally to the focus  $g$  of the astronomical eye-piece, which magnifies the image. Thus, the Amician refracting microscope is similar to Euler's, but with the ad-

vantage of reflecting the vertical image at a right-angle into a horizontal direction.

We shall now describe the accessory parts of this microscope: it has a foot to it, as usual; and a stem, which carries the body of it. The illuminating speculum *v*, the stage *g m*, which is raised and lowered by a pinion with a milled head to it, working in a rack, &c. These parts are nearly the same as in other microscopes of a similar kind.

As it is important that the prism *d* should reflect the light in a direction parallel to its axis, and in order to clean it occasionally from the dust which may lodge upon it, it is mounted upon a stem which carries a screw, the head of which *e* projects through the end of the tube; and by turning this screw, we can also move the stem of the prism, and it is easy thus to bring its plane surface *d* to the proper direction, of which we judge from its effects. If, however, we fail in attaining this purpose, a second screw *e* is also provided; by turning which, we can certainly obtain the desired result. The carriage of the illuminating lens *q*, is so contrived that you can easily dismount it when you would clean the glass, which is supported laterally between two blades of metal. It is also sufficient to loosen a screw to remove the prism from its mounting to clean it, and replace it at any time. The frame of the lens *q* is bent, in order that it may not touch the stem of the prism *d*, so as to disturb its position. We see that the rays enter the glass prism in such a manner that they strike the surface of its hypotenuse at an angle greater than forty-one degrees; and that instead of escaping through that face by refraction, they are, on the contrary, reflected. All the light transmitted through the achromatic object-glass is thus sent back by the prism.

This microscope has a fine effect, and its use is highly convenient. There is adapted to its stage a circular plate *j*, which turns upon an axis fixed to the side of the stage; and it has around it a number of circular holes or diaphragms of different sizes; any one of which can be

employed to cut off the useless light reflected from the mirror v. In order to illuminate opaque objects, a small silver concave speculum is used, which reflects the light thrown up from below by the mirror v upon the objects as usual; and is screwed upon the outside of the achromatic object-glasses. The lens j, mounted between its two branches or arms, also serves to throw light upon and illuminate opaque objects.

There can be likewise adapted, when we please, to the eye-end of the body of the instrument, a glass prism, forming a *camera-lucida*; by means of which, we are enabled to delineate upon paper the outlines of the magnified objects. There is also spider's threads stretched across in the foci of the eye-pieces, in order to render sensible the proportions, and to ascertain the sizes of the objects.

FR.

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### III.—*On the injuries caused by Weevils, and other Insects.*

By THOMAS CARPENTER, Esq.

DEAR SIR,

London, Dec. 10, 1828.

THE person from whom I received the weevils which are briefly mentioned by you in your last number, p. 380, called on me a few days since with several others, and which, on my examining them, I found to be of the same species as those he had before found amongst barley.—He stated, that having occasion to open a granary containing a great store of wheat, and which had been locked up for some time without having been properly attended to, he found that the increase of these insects had been so great, that they had nearly destroyed the whole stock of grain, which consisted of upwards of sixteen hundred sacks! The appearance which presented itself was that of large patches of black dirt spread over the whole surface of the wheat. On taking in his hand some of this apparent dirt, he was surprised to find it was composed of myriads

of the weevil, so destructive to grain, the *Curculio granaria*; one of which I now send for your inspection, together with an account of the manner in which these insects are produced. The female perforates a grain of wheat or barley with the jaws placed at the end of its long proboscis, and deposits a single egg within it; and when the young grub is excluded from the egg, it thus finds provided a fit dwelling, and a store of proper food. The parent insect thus deposits its eggs in five or six grains every day, for several successive days. In about seven days' time the larva is excluded from the egg, and, after feeding its accustomed time, changes into the cysalis state within the grain, and, in about a fortnight afterwards, comes forth a perfect weevil. I always thought that the parent insect, after depositing its eggs in situations where there would be a supply of food for the sustenance of its offspring, like many other of the insect tribes, died; but that does not appear to be the case with this species of insect; for, according to Leeuwenhoek, who paid great and close attention to the habits of these insects, both in their manner of breeding and feeding, for several months together, their existence is prolonged during the summer and throughout the winter: and that they also feed very voraciously on the interior of the grain both in the state of the larva and the perfect insect. Their prolonged existence, therefore, accounts for their vast increase and consequent depredations; for, according to Kirby, a single pair of these insects may, in one year, produce above six thousand descendants! We can therefore no longer wonder that the whole contents of a well-stored granary should, if neglected, be completely destroyed by them.

I think it would be worth while for the proprietor of a granary to establish a colony of ants near it; for, as these insects are continually engaged in searching for food, they would soon find their way into the interior of the granary, and feed upon the larva of the weevils; by which means their increase would be kept under, and the greater part of

the wheat, &c., be preserved. If you examine the above-mentioned insect under the microscope, you will perceive the strong jaws at the end of its proboscis above-mentioned; and also the various markings on the wing-cases, and its numerous eyes. There is also another species of insect, a small moth, *tinea granella*, whose larva is very destructive to corn and meal. In this state it commits its depredations, and is called by Leeuwenhoek "*the wolf*." I send you two specimens of this moth, and also two cases formed by its larva; one of which is cut open, thus showing the wolf within; the other has the wolf partly out, and as it appears to be when in the act of feeding. Three other larva, which I took from numbers found feeding upon some oats in my corn bin, and likewise two moths taken from many thousands of the same kind, which had bred within a bin containing eight bushels of bran; and the whole of which had been destroyed by them. I also send you a few scales taken from the wings and legs of these moths, and which you will find excellent test objects for your microscope. The mischief done by these insects is, when they are in the larva state only; for the female, after laying its eggs, dies. The number of eggs laid by one of these moths is about seventy; and they are less than a grain of sand in size. The grubs or larva come forth in about sixteen days, and immediately commence their depredations, and form themselves little cases, either from the particles which they gnaw off the corn, or from small portions of the bran, within which they reside, and feed by protruding the head and part of the body from the case; and when they are about to change into the pupa state, they leave these small dwellings, and seek places of safety. They then change into the crysalis, in which state they remain during the winter; and about April or May come forth the perfect insects. As these insects appear to be more voracious than the weevils, so it is highly necessary that they should be kept under. A watchful observer has two opportunities of destroying them if they happen to be

got amongst his corn ; one is, when the larva forsake their food and crawl up the walls, which they will sometimes almost cover ; the other, when they appear in the moth state. At both these times they may be easily crushed to death against the walls in great numbers, by pressing and rubbing sacks upon them. But they may be exterminated still more effectually, if, after closing up all the doors and windows, the corn-chamber be filled with the fumes of brimstone, by leaving it burning on a pan of charcoal, without giving it any vent for twenty-four hours. Great caution, however, should be used by opening the doors and windows, in order to let all the fumes disperse before any person enters the place, for fear of suffocation. The fumes of sulphur are in no wise hurtful to the corn, nor give it any taste. Leeuwenhoek fumigated a granary in this way, and it had the desired effect of destroying these pests. All the other produce of our gardens and fields is also liable to the attacks of insects. The depredations on the wheat, while in its growing state, by a small fly, *tipula tritici*, has often been the subject of my serious alarm,—a specimen of which fly I now send you, accompanied also by another minute fly of a different genus, the *ichneumon tipulae*, which appears to be created for the express purpose of keeping its increase within due bounds. The ichneumon deposits its eggs within the bodies of the caterpillars of the wheat flies, and thus prevents the increase of those insects ; which, if not kept under, would destroy whole fields of wheat. While the caterpillar is feeding within the ear of the wheat, the ichneumon deposits its egg, from which a larva is soon excluded, and immediately begins to feed upon the caterpillar of the wheat fly ; and thus prevents a fly from issuing forth that would lay many eggs, and each egg in its turn produce a caterpillar that would feed on the wheat. Such being the case, what a benefactor to the human race is this diminutive insect ; and how much ought we to admire and adore the wisdom and goodness of Divine Providence in thus setting bounds to the ravages of

an insect, which, however insignificant it may appear at first sight, might, if permitted to exceed its due limits, deprive us of the staff of life (bread), and even almost occasion the destruction of our species! The superstition of the ancients, had they been acquainted with the advantages which appear to be derived to man through the instrumentality of this important though minute link in the chain of creation, would have erected altars to it as a beneficent Deity. Can we, then, who enjoy the clear light of revelation, do less than adore and extol that Divinity which thus preserves a due balance in his works, and says to the destroyer, "Thus far shalt thou go, and no farther."—Indeed, the numerous species of the genus ichneumon seem to have been created for the purpose of keeping within due bounds the other tribes of insects, Any person who has observed the depredations committed in our gardens by the caterpillar of the cabbage-butterfly, may conjecture to what extent they would be carried were it not given in charge to the ichneumon of those insects to keep them within their assigned limits. In a word, were it not for this useful genus of insects we should not be able to stir, nor even breathe, without being annoyed; nay, even suffocated by myriads and myriads of troublesome insects, which are now kept within their proper bounds, and answer the ends for which they were created. Mr. Kirby mentions, that in 1788, an alarm was excited in this country by the probability of importing, in cargoes of wheat from North America, the insect known by the name of the Hessian fly. The Privy Council sat day after day anxiously debating what measures should be adopted to ward off the danger of a calamity, the more to be dreaded, as they well knew, than the plague or the pestilence. Expresses were sent off in all directions to the officers of the Customs at the different out-ports, respecting the examination of cargoes. Dispatches were written to the Ambassadors in France, Austria, Prussia, and America, to gain that information, of the want of which, they were now so sensible; and so

important was the business deemed, that the minutes of Council, and the documents collected from all quarters, filled upwards of two hundred octavo pages !

The ravages of the insect just alluded to, which was first noticed in 1776, and received its name from an erroneous idea that it was carried by the Hessian troops in their straw from Germany, were at one time so universal, as to threaten, where it appeared, the total abolition of the culture of wheat : though, by recent accounts, the injury which it now occasions, is much less than at first. It commences its depredations in Autumn, as soon as the plant begins to appear above ground, when it devours the leaf and stem with equal voracity, until stopped by the frost. When the return of Spring brings a milder temperature, the fly appears again, and deposits its eggs in the heart of the main stems, which it perforates, and so much weakens, that when the ears begin to grow heavy and are about to go into the milky state, they break down and perish. All the crops, as far as it extended its flight, fell before the ravager. It first showed itself in Long Island, from whence it proceeded inland, at about the rate of fifteen or twenty miles annually ; and in the year 1789, had reached two hundred miles from its original station. I must observe, however, that some accounts state its progress at first to have been very slow, at the rate of only seven miles per annum, and the damage but inconsiderable ; and also that the wheat crops were not materially injured by it before the year 1788. Though these insect hordes traverse such a tract of country in the course of the year, yet their flights on corn land are not more than five or six feet at a time. Nothing intercepts them in their destructive career, neither mountains nor the broadest rivers. They were seen to cross the Delaware like a cloud. The numbers of this fly were so great, that in wheat-harvest the houses swarmed with them, to the extreme annoyance of the inhabitants. They filled every plate or vessel that was in use ; and five hundred were counted in a single glass tumbler which was ex-

posed to them for a few minutes with a little beer in it. It may not be irrelevant here to mention, that wheat also, when growing, sustains a serious injury from two species of fungi, the seeds of which find their way into the stalk and ear; and so alarming was this disease at one period in this country, that it was considered necessary by the legislature to convene a council, with Sir Joseph Banks as President, in order to examine the cause, and adopt, if possible, measures to prevent its increase. The result of their investigation was published in the transactions of the Royal Society, and illustrated by accurate drawings of the disease in its various stages, made by that celebrated artist Mr. Bauer. On the former subject of the injuries caused by insects, I send you, in elucidation, four specimens of weevils, all of which were taken from a nut plantation in the grounds of a friend at Edmonton; who informed me, that although there were many bushels of nuts on the trees in the early part of the season, yet there were but few but had been destroyed by the numerous insects of this genus, the *curculio nucem*; and which insects are produced in the following manner:—The parent insect deposits on the outside of a nut, at the time when it is very soft and tender, a single egg; this she continues to do on other nuts until she has laid her whole stock. When the heat of the season has perfected the little caterpillar, it eats its way out of the egg, and through the shell, into the nut, without the least injuring the external appearance of the nut. Its chief food now is the coat of the nut, or that part which afterwards hardens into the shell; and it continues to feed on this and the interior pulp till such time as the one becomes too hard and the other too dry for its sustenance. It therefore begins to feed on the kernel, which is now grown so large as to afford it support; and it is to be remarked, that this seems a most providential instinct, for, had the insect commenced its attacks on the kernel when it was small, it would have destroyed that on which all its future welfare depended, and that which was the principal

food allotted it by Nature while in a caterpillar state. While feeding, it constantly attends to the hole by which it entered, gnawing away the sides so as to make them very round and smooth; for this not only allows it sufficient air, and a place through which it can expel the particles of its faeces, but it is also the passage through which, when it is full fed, and ready to undergo its change, it makes its way out. About the month of September, or perhaps somewhat later, the nut becomes ripe and falls to the ground. At this time the insect is generally prepared for its change, and works itself through the hole, which it is some time in doing, as it is much less in circumference than its body. It then buries itself in the earth, and, shortly after, changes into a crysalis, in which state it remains till the following spring; and, about the beginning of May, assumes the beetle form. Some species, which arrive later at maturity, and at a time when the nut is more grown, perforate the shell of the nut with the jaws which you may observe at the end of their proboscis, and then turning round their abdomen, deposit an egg within the opening they have made; and this operation they continue to perform until they have deposited, in different nuts, their whole stock; when results, similar to the first described, are produced.

I am, dear sir,

Yours sincerely,

To T. GILL, Esq.

THOS. CARPENTER.

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IV.—*On the Flea and other Insects.* By THOMAS CARPENTER, Esq.

DEAR SIR,

London, December 15, 1838.

I now send you herewith some thinner slips of glass than those I sent you last month; and between which are placed dissections from the heads of several fleas.

The muscular power of the flea is really astonishing, and

has formerly attracted much notice. Various curious experiments have been tried to ascertain its powers. Moufet relates that an ingenious English mechanic named Mark, made a golden chain of the length of a finger, with a lock to it, and which was dragged by a flea. He had heard of another that was harnessed to a golden chariot, which it drew with the greatest ease.

Another English workman made an ivory coach with six horses, a coachman on the seat, with a dog between his legs, a postilion, four persons in the coach, and four lacqueys behind it, and which also were dragged by a single flea. At such a spectacle one would hardly know which to admire most, the strength and agility of the insect, or the patience of the workman. I have in my possession a flea with a golden chain fastened round its neck, which I kept alive some time, during which, the insect dragged its chain about with the greatest ease; it is now dead, and preserved in spirits of wine, as a curiosity, and which I shall be happy to show you when you next favour me with a visit.

Latreille mentions a circumstance of a flea of a moderate size dragging a silver cannon, mounted on wheels, that was twenty-four times its own weight; and which, being charged with powder, was fired, without the flea being at all alarmed. Socrates appears to have measured the leap of a flea, and found it extended to two hundred and fifty times its own length; a most astonishing leap! It was as if a man of ordinary stature should be able at once to vault through the air to the distance of a quarter of a mile! The manner in which flies breed and undergo their metamorphosis are very singular, and somewhat similar to the silk-worm. I was curious enough to breed several in the following manner: Having examined the bed on which my dog lay, I collected a number of their eggs, which I put into a pill-box. In a few days the eggs produced hairy caterpillars, which I fed with dead flies, and which the caterpillars eat in a very voracious manner. I observed, occasionally, that they cast

their skins; and in about ten days after their exclusion from the eggs, they spun and wove themselves little cases after the manner of silk-worms, in which they remained enclosed in the crysalis state about nine days; and then came forth perfect fleas, armed with sufficient powers to disturb the rest or even the peace of an Emperor!

Leuwenhoek states, that when he dissected the head of a flea in order to discover the instrument it employed for piercing with, he only discovered a sheath and two piercers. Now, in all those which I have dissected, I have always found a sheath composed of two parts, with blades like knives, and *three other instruments*, viz.: two for piercing; and a tube for sucking the blood. In addition to which, I discovered (besides the pair of feelers at the top of the head) two antennæ, which lie within a groove, one on each side of the head, and which I pointed out to my friend, Mr. John Curtis, who assured me that all authors on Entomology had overlooked these organs; and that he considered me as the original discoverer of them.

It is fortunate that animals of a large size, as has been well remarked, and more especially noxious ones, have not been endowed with a muscular power proportionable to that of insects. A cockchafer, respect being had to its size, would be six times stronger than a horse; and if the elephant, as Linnæus has observed; was strong in proportion to the stag-beetle, it would be able to overthrow rocks, and even to level mountains. Were the lion and the tyger as strong and as swift according to their magnitudes as the *cicendela* and *carabus*, nothing could have escaped them by any precautions, nor withstood them by strength. Could the viper and the rattle-snake move with a rapidity and force equal to that of the *julus* and *scolopendra*, who could have avoided their venomous bite? But the Creator, in these little creatures, has manifested his Almighty power in showing what he could have done had he so willed; and his goodness in not creating the higher animals with powers

and a velocity equal to those of insects, which might have caused the early desolation of the world he had made.

I have just mentioned the insect *cicendela*, and as one species of that genus has some curious facts attached to its history, I now send you the larva, pupa, and perfect insect of that species, the *C. campestris*, together with a short account of its habits. The larva digs with incessant labour a cylindrical cave or burrow, in a warm sunny sand-bank, frequently to the great depth, when the size of the animal is considered, of eighteen inches. To effect this, it carries out small masses of earth upon its large concave head, and having often occasion to rest in ascending this height, Nature has provided it with a couple of strong hooks, which emerge from two tubercles on its back; with those hooks it fixes itself to the sides of its cave for that purpose, and having finally arrived at the mouth, casts off its burthen; its cave being finished, it lies with its head on a level with the threshold of its den, waiting patiently for its prey. It is furnished with six eyes, three on each side of its head, similar to those in some kinds of spiders;—its tremendous jaws are each armed with a strong internal tooth, with these it seizes any careless insect which crawls near enough, and then retreats backwards into its cave by means of its hooks, which appear to perform the office of feet; and then devours its victim; it then again returns to the mouth of its cave, and placing itself as before, waits in expectation of another unfortunate insect, and after thus feeding its accustomed period, it finally retires into the interior of its cave and passes into the pupa state. In the pupa I have sent, you will observe all the parts of the future insect enveloped within a thin transparent covering, through which the whole may be distinctly seen. When changed into the perfect insect, it presents a most splendid appearance, and, at the same time, its powers of destruction are increased; and the extreme velocity with which these insects can either run or fly, renders hopeless any at-

tempt of their destined prey to elude their pursuit. Well do they deserve the name given them of the tyger beetle, for they prey upon the whole insect race; their formidable jaws, which cross each other, are armed with powerful fangs, showing to what use they are applicable. In the larva state, you will observe it has six eyes; but if you examine the perfect insect you will find that the two apparent eyes are compound ones, consisting of many thousand distinct eyes. I have dissected one of these, and placed it between two slips of glass, and which I now send, and in which you will perceive the numerous lenses in the cornea; and also that in each lens the image of any object may be distinctly seen. Between the same slips of glass are likewise placed two of the palpi from the same insect. With these objects, I likewise send you five of our common field beetles, No. 1, the *elaphrus riparius*; No. 2, *E. cupreus*; No. 3, *nitrophilus biguttatus*; No. 4, *N. aquaticus*; and No. 5, *bombidium rufipe*, in order that you may examine their heads, thorax, and wing-cases. You will find in these the characteristics of a Divine workmanship; and they plainly show that the Almighty has set his peculiar marks on every work of his hands; varying the characters in the various species of insects, no work of his appears to be overlooked; every thing bears some impressive mark of his skill and wisdom; and every insect seems to be as much under his care, and equally provided for, as the higher orders of animals. Witness the instinct he gives to all the insect tribes to deposit their eggs on such plants and in such places as will afford immediate food for their young when excluded from them; yet, in numerous cases, the parent insect, in its perfect state, never feeds at all; or, if it takes any sustenance, it is merely the nectar of flowers.

The colours of some insects are splendid beyond description. The *cynips rosa*, for example, which we have together so often contemplated with delight under the microscope. The piece of butterfly's wing, which I now send you, also

affords another proof of the exquisite skill displayed by its Creator; place it under your microscope and you will then observe that the wing is covered with two layers of scales or feathers, in a similar manner to the slates placed on the roof of a building. Now remove one of those scales which is almost invisible to the eye, and place it under that inlet to another sense, the microscope, and you will perceive in this nearly invisible speck nine or ten rows of most exquisite chasing or embossing. Again, examine one of your own wheel-animalculæ, whose natural size is considerably less than the point of a fine needle, yet you will perceive as much organization and machinery displayed therein as in the large animals. Other animalculæ in your possession also exhibit organs equally numerous, although not half their size.

“ Gradual from these, what numerous kinds descend,  
Evading e’en the microscope itself!  
Full Nature swarms with life: one wond’rous mass  
Of animals, or atoms organized,  
Waiting the vital breath when parent Heaven  
Shall bid his spirit blow.”

One would at first think that a view of the intestines of any animal, could, under no circumstances, afford any very pleasing spectacle to the eye of any but a scientific spectator; but any lady who is fond of going to an exhibition of fine lace, would experience an unexpected gratification could she be brought to examine those of a caterpillar under a microscope; with what wonder and delight would she survey the innumerable muscular threads that in various directions envelop the throat, stomach, and lower intestines of one of these little creatures; some running longitudinally, others transversely; others again crossing each other obliquely, so as to form a pattern of rhomboids or squares; others surrounding the arteries and veins like so many rings, and almost all exhibiting the appearance of being woven, and resembling fine lace; one pattern ornamenting one organ, another a second, and another a third.

This will suffice to give her some idea of this part of the muscular structure of these little creatures ; and for the astonishing number of muscles in these despised insects I can refer to page 281 of your last volume.

Perhaps we have been too much accustomed to look upon insects as so many rude scraps of creation, and to rank them accordingly amongst the refuse of things. Whereas, if we examine them without prejudice, and with a little attention, they will appear to form some of the most polished pieces of Divine workmanship ! Many of these are bedecked with a profusion of finery. Their eyes are an assemblage of microscopes, whose mechanism is inconceivably nice, and finished in the highest perfection. Their dress has all the variety and lustre of colours ; it is set with an arrangement of the most brilliant gems, and bordered with fringes richer far than those of the most costly silks. Their wings are the finest expansion imaginable ; cambric is mere canvas, and lawn as coarse as sackcloth, when compared with those inimitable webs.

The cases which enclose their wings glitter with the most glossy varnish ; they are scooped with ornamental flutings, and are studded with radiant spots, or pierced with elegant holes. Not any among them but are equipped with weapons ; or endowed with a dexterity, which qualify them to seize their prey, or escape from their foes ; to dispatch the business of their respective situations, and enjoy the pleasure of their particular conditions.

If we turn our eyes to the minutest parts of animal life, we shall be lost in astonishment ; and though every thing is alike easy to the Almighty, yet to us it is a matter of the highest wonder that in these mere specks of life we find a greater number of members to be put in motion, more wheels and pullies to be kept agoing, and a greater variety of machinery ; more elegance and workmanship (so to speak) in their composition ; more beauty and ornament in their finishing, than are seen in the enormous bulk of the

crocodile, the elephant, or the whale. Hence we learn, that an atom is to God as a world; and a world but as an atom! Just as to him one day is as a thousand years, and a thousand years but as one day. Every species likewise of these animalculæ may serve to correct our pride, and show us how inadequate our notions are to the real nature of things. How extremely little can we possibly know either of the largest or the smallest parts of the creation. We are furnished with organs capable of only discerning to a certain degree of great or little; all beyond is as far above the reach of our conceptions as if it had never existed! The little insight that we do obtain into Nature's works are really all of them the offspring of scientific research; yet, partial and uncertain as our labours are, a brief gleam will occasionally enlighten the darksome path of the humble inquirer, and give him a momentary glimpse of hidden truths! Let not then the idle and the ignorant scoff at him who gives an unemployed hour to investigate an insect, a shell, or even a leaf of moss, "in ways of pleasantness and paths of peace." They are all the formation of a Supreme Intelligence, and lead us, by gentle gradations, to a knowledge of infinite wisdom; they have calmed and amused many of us in our earthly state, and have bettered us for our change to a new and more perfect state of being.

"The humblest bud that blossoms to the morn,  
The meanest insect on its bosom borne,  
Live by the fiat of that Mighty Hand,  
Who launched the spheres, and bade the skies expand."

In no part of his works is the hand of an Almighty and All-wise Creator more visibly displayed than in these minutæ of creation; so that they are equally as worthy of the attention and study of the Christian philosopher as any of the higher departments of the animal kingdom. And all praise is due to Him, for placing before our eyes,

for our entertainment and instruction, such a minute but beautiful moving picture of symbols and agents, perpetually reflecting his glory, and working his will.

“ How sweet to muse upon his skill display’d  
(Infinite skill) in all that he has made:  
To trace in Nature’s most minute design  
The signature and stamp of pow’r divine;  
Contrivance intricate, express’d with ease,  
Where unassisted sight no beauty sees;  
The shapely limb, and lubricated joint,  
Within the small dimensions of a point;  
Muscle and nerve, miraculously spun,  
His mighty work, who speaks, and it is done;  
Th’ invisible, in things scarce seen reveal’d,  
To whom an atom is an ample field\*.”

I am, dear sir,  
Your obliged friend,

To T. GILL, Esq.

THOS. CARPENTER.

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#### IV.—*On Improvements in Marbling the edges of Books and Paper*†.

THIS art is confined to a few persons only, who take great pains to preserve it secret, and will not make any communications thereon, but under considerable remuneration. One of the most skilful workmen in Paris, to whom I had rendered some essential services, was, however, willing in return, to initiate me in his mysteries, and execute his processes before me; and he likewise furnished me with the necessary details, to enable me to describe them; not, however, without my engaging to conceal his name, lest it might draw upon him the animadversions of his fellow-workmen. The following is the process :—

The utensils employed by the marbler are not very nu-

\* Cowper’s “Retirement.”

† From the *Dictionnaire Technologique*, 1828.

merous :—Firstly, a vat, formed of oaken planks, well fitted together, so as to be perfectly water-tight. Secondly, a small cylindrical staff. Thirdly, several earthen vessels, to contain the colours and other preparations. Fourthly, a small portable stove, or furnace. And fifthly, a grinding stone, of porphyry or marble, and a muller, to grind the colours, are, however, indispensable requisites.

*On the preparation of the gum.* We put into a proper vessel, half a pail full of water, or about seven or eight litres, and dissolve in the cold, ninety-one grammes (three ounces) of gum tragacanth, stirring it frequently for six days : this is termed the *couch*, or *bed* ; and upon this bed are to be spread the colours which serve to form the marbling ; they do not, however, mingle with each other. This quantity of gum is sufficient for marbling the edges of four hundred volumes.

We must likewise provide a solution of gum much stronger than the above, in order to encrease the thickness of the bed, when necessary ; of which we make proof in the manner to be hereafter described.

*Preparation of the ox-gall.*—We put the gall into a dish, and add to it an equal weight of water, and beat the whole up well together ; we then add to it eighteen grammes of camphor, which has previously been dissolved in twenty-five grammes of alcohol, and again beat up the whole thoroughly, and pass it through a filtering paper. This preparation should not be made earlier than the day before it is to be used, lest it should spoil by keeping.

*Preparation of the wax.*—Over a slow fire, and in a glazed earthen vessel, we melt yellow virgin wax ; when it is melted, it is withdrawn from over the fire ; and we then mix with it, by degrees, and stirring it continually, a sufficient quantity of essence of turpentine, to give it the consistence of honey. We ascertain when it has attained the proper degree of fluidity, by putting a drop of the mixture upon the nail, from time to time, and letting it cool ; and add more of the turpentine if it is too thick.

Like the ox-gall, the wax must not be prepared too long before using it.

*Of the colours.*—We do not employ the heavy mineral colours in marbling; animal and vegetable colours, and the ochres, are the only ones which can be employed with success. The other mineral colours are too heavy, and could not be supported upon the surface of the gummed water.

*For yellow,* we employ Naples yellow, or the yellow lake from weld. The golden yellow is made with *terra de Sienna*, in its unburnt state.

*For blues,* of different shades of strength, we use the best indigo, known by the name of “the flower of indigo.”

*For red,* we either employ carmine, or carmine lake.

*For brown,* umber.

*For black,* ivory black.

*The white* is produced by the gall itself.

*Green* is produced by the mixture of blue and yellow.

*Violet,* by yellow and red.

*And aurora,* as in ordinary paintings.

The *terra de Sienna*, the flower of indigo, and the carmine lake, are employed separately, in the manner we shall describe, and make very fine and sharp figures, which may be varied to infinity.

*On the preparation of the colours.*—These are to be ground very fine, and made into mixtures, of the consistence of a thick soup, or *boullie*, either upon the slab of porphyry, or one of marble, with the prepared wax and water, together with a few drops of alcohol. When they are well ground together, we take up a small quantity of the colour with a palette-knife, which we incline, and let the colour fall upon the surface of the gummed water, to prove its consistency. When each colour is ground and mixed up, it must be put into a pot, and kept apart from the others.

*On the preparation of the marbling vat.*—From the vessel which holds the prepared gum, we take a sufficient

quantity of it to cover the bottom of the marbling vat, to the depth of an inch at least. We then add 200 grammes of alum, in fine powder, and beat it well up, to dissolve the alum. We then put a spoonful or two of this prepared water into a conical confectionary pot, in order to make the necessary trials with it, to ascertain whether the gummed water be of the proper consistence for use, as follows:—

We take a little of the colour which has been ground of a sufficient consistence with the prepared ox-gall, and throw a drop of it upon the gummed water in the conical pot, and stir it in a circular manner with the small rod. If it extend well, and form a spiral figure, without dissolving in the gum, it is sufficiently strong; if, on the contrary, the colour will not turn, the gummed water is too thick, and water must be added to it, and be well mixed with it, by beating it up; but if the colour spread too much, and dissolve in the gummed water, then some of the stronger prepared gum water must be added to it, which was kept in reserve for this purpose. At every time of adding either water or gum, the whole must be well beaten up to make the mixture perfect. After every trial, the conical vessel must be emptied, and its contents thrown aside, and a fresh portion of the gummed water employed. When we have thus brought the gummed water to the desired consistence, it must be passed through a sieve into the marbling vat, to the height of an inch, as we have before said.

The marbling vat being thus prepared, and all the colours ground and thickened with the prepared wax, and ox-gall, so that they be not either of too thick, nor of too thin, a consistence, we first take the gall, and spread more or less of it upon the gummed water. The colour which we first throw on is less thick than the succeeding one, and that again thicker than the first, and so on. We first throw on the red for instance. All the other colours intended to be used are then thrown on, one after the other; that which

is laid on second, presses the first on all sides; and as the number of the colours is the more considerable, so the first is spread, and occupies a larger space. When all the colours which we would employ are thrown on, if we desire that the marbling should take the form of a volute or spiral, we hold the rod upright, and then carry it along amongst the colours in a spiral manner. The colours are thrown on with a kind of pencil made by the marblers, thus:—They take for the handles the twigs of osier, about a foot long, and two lines in thickness; they also employ about a hundred hog's bristles for each pencil, and of the greatest length possible; they arrange these bristles all around the smaller end of the twig, and tie them strongly with packthread. These pencils, with their long bristles, more resemble brooms than pencils. With the assistance of these pencils, they throw on, here and there, all over the gummed water, the first colour; then, in the middle of that, the second; then the third, &c.; so that when they are spread, these sets of colours approach one another; they then stir them in a spiral or other shape, as they judge necessary. We shall give an example:—

Suppose we would give the marbling the form known by that of "*the partridge's eye*." We prepare two tints of blue with the flower of indigo; the one, such as we have before-mentioned, and which we designate by the name indigo, No. 1; the other, in a different vessel, and to which we add a larger proportion of the prepared gall, and term indigo, No. 2, we first throw on the carmine lake; secondly, the *terra de Sienna*; thirdly, the indigo, No. 1; and fourthly, the indigo, No. 2; after which we throw on, with a jerk, two drops of essence of turpentine.

The blue, No. 2, last laid on, extends all the other colours, and affords a clear blue in spots, which produces a fine effect. It is to the essence of turpentine that this effect is owing; we should therefore add a little of it to all the colours which are to be thrown on last; it would be useless to mix it with the preceding ones.

When all is thus disposed, the marbler takes eight or ten volumes, and commences by marbling their front edges, which he first prepares by laying the back of each volume upon a table; he then turns back the boards, and applies a clamp, which he affixes by screwing its jaws close, and thus levels the front edges. He does the same with all the other volumes; he then takes each up between both his hands, and plunges it into the vat. Thus the front edges are marbled.

He then takes the same volumes, loosens the clamps, and strikes upon their ends to make them all enter the gummed water at the same level; he then again clamps them and treats them in a similar manner.

The marbler can vary his patterns *ad infinitum*; they depend upon his taste both in the arrangement he gives to every colour which he employs, and in the number of the colours used.

Paper is marbled in the same manner, and with the same colours, prepared and thrown upon the gummed water in the vat, as the edges of books. But instead of using a round staff, we use combs, with teeth more or less apart, to form the volutes, or any other figure we please, and which may be varied to infinity.

All the address consists in adroitly placing the sheet of paper flat upon the surface of the gummed water which supports the colours, and to withdraw it again without deranging them. In order to do this, the workman takes between the thumb and fore-finger of one hand, the sheet, in the middle of one of its ends; and with the other hand, and between the thumb and fore-finger also, the middle of the other end of the sheet. He then lays the sheet upon the gummed water, and again removes it, without suffering it to slide upon the coloured surface. He then hangs the sheet upon the bar of a frame, with the coloured side outwards, to evaporate the water, and to dry it.

This sheet being thus finished, he marbles a second, and

soon; but he always adds fresh colours after every one is dipped.

When the sheets are dry, they are waxed, glazed, and folded for sale.

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VI.—*On Improvements in the Manufacture of Sliding-Rules.* By Mr. SAMUEL DOWNING.

THE change caused by the adoption of the imperial weights and measures, rendered, of course, the old sliding-rules used in gauging, &c. useless; and made it necessary to create a large supply of new ones for the use of the excise. This necessity also caused ingenious men to turn their abilities to account, in contriving more facile means of multiplying the logarithmic and other scales upon them, than by the old and tedious method of transferring copies of the original divisions to the stocks and slides of the rules, by the help of the square and dividing knife, and the marking punches, &c. usually employed. One of these ingenious workmen, Mr. Samuel Downing, lately gratified the Editor with a sight of several of the instruments which he made expressly for this purpose, and which completely answered, in producing thousands of sliding-rules, equally accurately formed and divided as the original patterns were, which were given him to copy. And, although a similar cause for such an extraordinary display of talent may not again occur in our days, yet it is highly desirable to record some of the methods then had recourse to by him, for the benefit of other countries, as well as our own.

*On a compound plane, for rebating the edges of the slides.*

—It is highly necessary that the slides of these rules should accurately fit the grooves in their stocks; but instead of using the single-ironed rebating planes, commonly employed for this purpose, Mr. Downing made a *compound plane*, in which no fewer than *thirty-six irons* were com-

bined, in opposite pairs; and each individual iron of which performed its part, in cutting a distinct shaving in succession, off the slide, as it was driven along through them by the workman! In this manner, and in an instant, the slide was perfectly equalized in its breadth throughout, at one operation only. Mr. Downing passed a slide, formed as usual, of box-wood, and previously planed to a proper breadth and thickness, through this compound plane, and convinced the Editor of the fact above stated, from an ocular proof thereof.

On the Editor questioning him how it was possible to adjust the irons so as to cause each pair of them to cut sufficiently, and yet not take off too much from the slide, in its passage through them? he said it was done with the utmost facility, and in the following manner:—Each individual iron was bound fast in its place by a screw, instead of a wedge, as in ordinary planes; and, on loosening the screws, and placing the prepared slide between the first pair of irons, he merely brought each iron into contact with the sides of the slide, by gently pressing equally on both their outward ends, and then secured the irons tight, by binding the screws upon them. On bringing the slide back from between the irons, and again pushing it forwards a little, he then found that each iron had performed its intended office, in taking off a thin shaving from the edges of the slide. This part of the slide, thus reduced, was then placed between the next pair of irons, and which were also, in their turns, adjusted in a similar manner to the first pair, and performed their part in farther reducing the sides of the slide, when pushed through them. In short, by thus repeating his trials, and altering the forms of the edges of his plane-irons, as was indicated by the effect produced by them upon the slides, he finally adjusted the plane to the degree of perfection requisite.

The body of this compound plane was formed of hard Spanish mahogany, and each iron had its separate eye to

it; and the plane being laid in a horizontal position, the shavings escaped from the holes made on each side of it, on passing the slide through them, by the help of another instrument, which had handles to it like those of an ordinary narrow plane, and which was passed through a slit, formed in the middle of the compound plane, so as to reach down to the slip of box-wood, or slide, placed below it; and by means of a thin projection formed on its under side, to catch hold of the slide, and carry it along with it through the plane. It is, however, obviously quite impossible to describe these instruments accurately, without furnishing figures thereof.

*On the steel types employed for imprinting the divisions and figures upon the sliding-rules.*—In order to avoid the risk arising from hardening and tempering steel, after finishing it, as usual, and which might have considerably lessened the accuracy of the workmanship of these *steel types*, Mr. Downing very judiciously formed them of cast-steel bars, forged to a proper thickness, length, and breadth; and previously hardened and tempered down to the *spring temper*, so as to be just capable of being filed by hard Lancashire files. In this manner, and with the sacrifice of a few files only, and considerable patience and skill, he succeeded in transferring to sharp ridges made across the flat edges of several of these bars, by filing away, on each side, the original logarithmic and other divisions of the pattern scales furnished him; the letters and figures being also, as usual, cut or raised on the edges of other steel bars. These bars were then combined in proper order, in strong metal frames, which were placed within the still stronger frame of an iron press, actuated by a screw in its centre, with a lever to it; and which screw urged forwards a stout bar of iron, made flat on its inner edge, and guided by the sides of the press-frame. The whole being laid upon a proper flat support, the stock of the sliding-rule, or the slide, as it might be, was placed in contact

with the faces of the corresponding steel bars or types, with the raised divisions, &c., upon them, and a bar of hard-wood was then laid at their backs, and between them and the moveable bar of the press; and, on a due pressure being exerted, the types were thus indented into the surfaces of the box-wood stocks or slides. And, in case of an undue degree of pressure being given to some parts over others, Mr. Downing equalized it by removing the corresponding parts of the surfaces of the bars of hard-wood, which were, as above-mentioned, placed behind them in the press, by scraping them, so as at length to produce the desired effect.

The lines drawn lengthways along the divided surfaces of the sliding-rules, were produced in the usual manner, by the help of toothed gauges passed along them: and the blackening of them and the divisions was likewise effected in the usual manner of the rule-makers; namely, by wiping the surfaces over with fine charcoal, ground off by rubbing a piece of charcoal upon a proper stone with linseed oil, and working it into the divisions; and which was afterwards cleaned off the plain surfaces of the rules, and thus left the charcoal and oil firmly fixed in the indentations.

We are sorry to add, that after all the great pains taken by Mr. Downing to insure accuracy and dispatch on this important public occasion, and the execution of several thousand sliding-rules, he finally lost his reward, owing to the failure of the person by whom he was employed.

The grooves in the stocks of the sliding-rules were formed in the usual manner, by planing them and undercutting them with proper tools; but which does not require such skill as in the equalizing of the slides.

VII.—*On Two Circular Instruments answering the purposes of Sliding-Rules.* By Mr. B. BEVAN, Civil Engineer, and Mr. LAMB.

Mr. BEVAN lately favoured the Editor with a sight of one of these very portable and convenient substitutes for the sliding-rule, which he had caused to be made in the following manner:—

In a circular plate of brass, of about three inches in diameter, a cavity was formed deep enough to receive another thin circular plate within it, and having a flat rim around its face, with logarithmic divisions formed upon and around it, corresponding with those upon and around the face of the circular plate. Both plates had likewise central holes, into the larger one of which a steel stud was firmly affixed, having a short cylindrical stem formed upon it, on which the smaller or moveable plate turned. A groove was also formed around the upper part of this stem, into which the forked end of a thin steel spring was fitted, which was secured to the moveable plate by screws; and, springing outwardly, it produced a proper degree of friction to retain the moveable plate at any required situation, and also prevented it from coming off the steel stud.

This instrument was very portable, and completely answered its purpose.

On mentioning this circumstance to Mr. S. Downing, he immediately showed the Editor another circular instrument of the same kind, which was made by a Mr. Lamb, an ingenious workman as a watch-maker, of his acquaintance; this instrument was smaller and lighter than Mr. Bevan's, and was formed of a circular plate, with a cylindrical rim, accurately fitted *by springing*, into a circular ring, with a groove inside it, like a spectacle-frame; and such was the great nicety of the workmanship, that the plate turned in its frame with a proper degree of steadiness to enable it to remain in any required position. By this construction, not only *great lightness* was obtained (a very desirable thing),

but it likewise afforded a facility in forming logarithmic divisions on both faces of the instrument, as in a double and triple ratio for instance; whereas Mr. Bevan's instrument can only admit of receiving one series of divisions upon it. Both are, however, exceedingly valuable instruments; and we must ever consider any facilities which can render these expeditious, portable, and convenient *ready-reckoners* more generally employed than at present, as highly serviceable; and the more especially since Mr. Bevan has furnished us with the means of rendering them serviceable in a great variety of ways little thought of by the world in general.

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#### VIII.—*On Morocco Leather-Dressing*.\*

THE true Morocco leather is made of goat-skins, tanned and dyed on their outsides. Sheepskins are treated in a similar manner. It seems that this leather is termed *Morocco* leather, from the art of dressing it being originally brought from that country.

This manufacture was established in France, towards the middle of the eighteenth century. The first accounts of the manufacture of Morocco leather in the Levant, were given by Granger, a surgeon in the royal navy, and an excellent observer; who made voyages to different countries, by order of the minister, the Count de Maurepas; and successively transmitted to the Academy the most valuable discoveries in divers branches of the manufactures, as well as in natural history. His description of the art of dressing Morocco leather, which, with other processes, he saw executed in the Levant, is dated in the year 1735, and the details of it were published by Lalande, in the *Encyclopædia*. Since this period, many establishments for dressing Morocco leather have been formed in France, and especially that of M. Fauler, at Choisy-le-Roi, which is become

\* From the *Dictionnaire Technologique*, 1823.

the most important and celebrated, for the superiority of its products.

It would be useless for us to describe the details of this manufacture in its commencement; and which followed the processes described by Granger, and published by Lalande. They have also lately been much simplified in their manipulations, and improved in others which were hurtful; so that the manufacture has received some real improvements. We shall now proceed to describe several of these ameliorations.

The skins which are employed in this manufacture, are, as we have abovesaid, those of goats and sheep. The first of these are not only more pliant, but their surfaces are smoother, and they are likewise more durable than those of sheep, but their employment is restricted, on account of their high price.

The manufacturers in Paris procure their goat-skins from various places; in France, those from Auvergne, Poitou, and Dauphiny, are preferred. They also procure quantities from foreign parts, and especially from Switzerland, Savoy, and Spain; the last, in particular, are much sought for, on account of their strength and other good qualities; so also those of France are esteemed for their thinness. The manufacturer has it thus in his power to make his choice in regard to these qualities, and also to lay aside those skins which appear defective, or are unfit to receive the finer dyes, especially the reds. It is nevertheless impossible, with all his care, to perceive in this selection the slight cuts made in the skins by the knife of the flayer; or the small lumps left in them, from the punctures of insects, but which are, however, sufficient to render the skins greatly defective, when they are to be dyed red, which is a colour the most delicate, and requires the highest perfection in the skins: and thus the manufacturer is frequently obliged, in the progress of the manufacture, to submit his skins to new inspections, and to class them for dyeing; that is to say, to reserve the defective ones for the darker tints,

and employ the finer ones for the brighter colours, and especially for the reds.

The goat-skins are received in packs, in a dry state, and therefore the first process they are subjected to is intended to soften them, and to open their pores, in order to enable the substances employed in the succeeding operations to penetrate them. This object is readily obtained by immersing them in stagnant water for a longer or shorter time, according to their degree of dryness, their thickness, and the temperature of the season. In this first steeping they undergo a kind of fermentation, which cannot be carried too far, without danger of their beginning to putrify, and consequently necessarily altering their quality. It is practice only which can guide them, as to the length of time required in steeping them; and which may be from two to five days. When they think that the skins are sufficiently softened, they avail themselves of this state to give them their first dressing upon the horse, in order to separate any morsels of fat or flesh which the butchers may have left upon them, and which were not visible in the folds which were formed in them during their drying. After this preparation, they are again steeped in fresh and cold water for twelve hours, and are lastly rinsed in similar water.

When the skins have been well drained, they are put into square pits, filled with lime, mixed more or less with water. These pits are generally constructed of stone or wood, and are about four or five feet long, and as many deep. The intent of this new immersion is to dilate the reticular tissue, and thus to loosen the roots of the hair, and permit it to be removed easily. In this, as well as the preceding operation, certain changes occur, which habit only can indicate. Thus, it is by no means a point of indifference to leave the skins for a longer or shorter time in the lime, it is also necessary to graduate its action, and to follow a series of continued observations, in order to seize the precise moment when the proper effect has been pro-

duced ; as, otherwise, the lime, by a too prolonged action, may exercise an injurious influence, and the skins will become swelled and spongy. We thus see, that we must carefully guard against the corrosive action of the lime, according to the greater or less fineness of the skins, and the temperature of the atmosphere ; as it is certain that its action is greatly accelerated, when the heat of the air is increased.

In order to proceed with more certainty, the steeping of the skins in lime-water is usually commenced in those pits where, from length of time, the lime has become partly carbonated, by remaining in contact with the air, and its action has become less energetic, and then to finish with those pits in which fresh lime has been put. It is also necessary in this process to observe a due period throughout ; and that its progress be neither too quick nor too slow. If the pit be too strong, it will be seen that the skins are powerfully attacked by the lime, after a day or two's immersion, and it becomes necessary therefore to remove them into a weaker one. If, on the contrary, we find at the end of twelve or fifteen days, that the hair is not loosened, then we must have recourse to a pit capable of acting upon them with more power. We must also take care, during each immersion, not only to lift the skins from time to time, in order to permit the lime to renew itself, and to penetrate both sides of the skins, but we must also take them out of the pit, and replace them again, at least once in every two day's time.

When they have been steeped for the proper time, they are taken out of the pits to be scraped, in the following manner :—Each skin is stretched over the horse, and with the aid of a blunt round knife, similar to that used by the tanners, the hair is removed ; in order to do this, it is sufficient to pass the knife backwards and forwards over the entire surface of the skin, at the same time exerting a slight degree of pressure. This operation being finished, they

proceed to the succeeding one, which consists in completely freeing the skin from the particles of lime contained in it ; this is highly essential to the final success of the process, which the lime would entirely frustrate, by giving to the dyes a great number of shades, which, from their multiplicity, would be exceedingly expensive to remove. This process has, however, lately been greatly simplified, without lessening the final perfection of the work. They commence by laying the skins to cleanse themselves in a river for one or two days. They then proceed to clear the skins from any small portions of flesh which may still adhere to them. This operation requires great care, and considerable practice, to detach them cleanly, and without injuring the skins. At this time also they shave and equalize the thickness of the skins.

They next dress the hair sides of the skins with the *querce*, which is a long flat plate of stone, of a fine and hard quality, being a species of hard schistus, and which is inclosed half its width in a piece of wood, of which the ends project eight or ten inches on each side, and are rounded, to serve as handles ; this species of blade, or stone knife, has its edge rounded ; with this instrument, they expel, by the slight pressure they exert in using it, the last remains of the lime which adhered to the skins, and at the same time soften the hair sides of them. Then, after having well drained the skins, they repeat the process of rubbing upon the flesh sides of them, and compressing them strongly upon the horse, with the round blunt-edged knife ; they are now ready to undergo the preserving process.

Formerly, between each operation, and they were very numerous, they pressed and beat the skins in wooden vats, by means of wooden rammers or pestles. But now they are content to beat the skins about for a quarter of an hour each time, in a barrel, mounted horizontally upon two necks or pivots, and the inside of which barrel is furnished

with a great number of wooden pins rounded at their ends. They introduce the skins into this vessel, and a quantity of water proportioned to their number; and, after closing it, they turn it rapidly round by means of a handle or winch affixed upon the axis of a toothed wheel, which acts in a pinion affixed upon the axis of the barrel.

We have before spoken of the inconveniences which the lime occasions when its action has been too long continued; and we may now add, that it was no doubt in order partly to remedy these that many manufacturers diminished the quantity of the lime, and supplied its want by employing a proper proportion either of wood-ashes or of common pot-ash; and which probably produced the same advantages without being attended with those inconveniences. We are besides strengthened in this idea by the knowledge that other persons have recommended the employment of stale urine for a similar purpose, and which we regard as infinitely preferable for this kind of work, probably on account of the ammonia which it develops. It seems to result, from this reasoning, that those alkalies which are the least caustic merit the preference, whilst they still possess their cleansing properties, and they are easily removed by slight washings; whereas the lime is much less soluble, and, in the state of division in which it is employed, it introduces itself within the pores of the skin, where it remains; and combining with the organic matter, communicates new properties to it. It is certain, that let them take all the pains possible to remove the last remains of the lime, not only do the skins preserve their rigidity, but the presence of this alkaline earth acts as a kind of mordant upon the dyeing materials employed, and modifies them so as to produce many various tints totally different from that which was designed to be given to the leather.

We see, after what has been above stated, how very important it is that the lime should be entirely extracted; and it is this, doubtless, that rendered necessary the preliminary operations before dyeing the skins; nor can we

otherwise conceive the utility of that which is termed *le confit*, an operation with which we are now occupied.

In the description of this process, published by Lalande, we find a third bath mentioned, to which he gives the name of *le confit*; this is nothing else than dog's dung, mixed with water to the consistence of thin soup, and in the proportion of from twenty-five to thirty pounds for eight dozen of skins. The author pretends that this *confit* removes their rawness, and disposes them to soften or swell during their fermentation; and, which is more, that this dung cleanses the skins by the action of the alkaline parts which it contains, and facilitates the removal of the grease which they retained, and which hindered them from taking the desired colours. Now we are ignorant upon what facts these various assertions are founded; and we must say, that it is scarcely likely that the skins should retain any appreciable quantity of grease after the cleansing processes they have been subjected to, and where the lime and the potash employed must necessarily have produced the effect of converting it into a soap more or less soluble. We may then suppose that the real utility of this bath is to bring on that species of acid fermentation which precedes putrefaction. What leads us to this belief is, that we know most of the manufacturers of Morocco leather have entirely discontinued the use of this dung-bath, and only use a sour bath made with bran, which can only produce a certain proportion of acid, and which we believe acts by swelling the skin, in consequence of its acid generating carbonic acid with the remainder of the lime which the skins may retain. We also believe that it is this acid which produces the swelling spoken of by Lalande, and which he believes tends to prepare them the better for tanning.

However this may be, when the skins have undergone the different processes, and have been well washed, they are last immersed in a bath of sour bran, where they are left for a day and a night; they are then hung upon the horse to dress or clear them, and those which are intended

to be dyed red, that is to say the finest skins, are immediately salted, in order to preserve them until they are to be dyed.

We may observe, on this last point, that the salt most probably performs another office, and that it not only preserves the skins, but it is a fact, that whenever salt comes into contact with soft animal substances, it first swells them up; but it afterwards causes a great part of the water which they had absorbed, to flow out; and then makes them shrink. This effect is particularly remarkable in the intestines of animals, which are salted in order to preserve them; and we do not see why the same effect should not happen with respect to their skins, the cellular tissue of which is contracted by the salt; and as the salting precedes the dyeing, it may be presumed that it also favours the latter process, by rendering the surface of the skin more compact and smooth. Another advantage likewise results, which is, that the skin becomes less porous and more difficultly penetrated by the dye, and which consequently can be used with more profit. From a similar motive, each skin is folded double, and stitched along its edges, with its hair side outwards, in order that the dye may not be applied to the flesh side.

*On dyeing Morocco Leather Red.*—It is difficult to give precise rules for this process, because every manufacturer makes a great mystery of his own method, notwithstanding they all follow processes differing but little from each other. But although we cannot warrant the accuracy of every thing we shall describe, yet we shall endeavour to expose so much of the leading principles of the process as may safely guide every one to obtain the desired result after making a few trials.

We know that most of the colouring materials are only to be fixed upon the surfaces of the articles to be dyed by the intermediation of particular substances, known by the names of *mordants*; and that these mordants are varied according to the nature of the articles to be dyed, and also

according to the time required. We also know that animal substances combine more readily with colouring matters, than vegetable ones. This premised, we also learn from many authors that the skins of goats may be dyed red by means of kermes, or scarlet grains, by lac-lake, and also by cochineal. And we have been lately informed that a fine red dye may be obtained from madder, but we have no positive knowledge of this latter fact. Kermes, as every one knows, will not produce all the tints of red which are afforded by cochineal, and they are also less brilliant; but then they possess more durability: and before the discovery of cochineal, kermes was always employed for this purpose. And we may remark, that as in the Levant, from whence we have derived our manufacture of Morocco leather, they always dye their *gasquets* or bonnets with kermes; so it becomes very probable that they also use kermes to dye their Morocco leather with. But we know that the Morocco leather-dressers here also use cochineal; and which really deserves a preference, on account of the brilliant colours which it affords with a proper mordant.

Some of the older authors, and particularly Geoffroy, have affirmed that the red colour of Morocco leather was produced by the use of gum-lac in grains; but we are ignorant of the processes employed, or what degree of confidence they merit. We have, however, no doubt that it is possible to employ it for this purpose, and we are the more convinced thereof, because we have lately substituted the lac-dye produced from it, for cochineal, in most other manufactures; and we should therefore probably succeed in employing it in this, which is the more desirable, since cochineal has now become so scarce and dear, were we only to take the pains to make a few experiments on the methods of using it. In the mean time, we shall make known the processes actually followed, as described by several learned authors.

The skins intended to be dyed red, being supposed to be

properly prepared, and entirely freed from the lime, but not tanned, are each doubled singly with the flesh side inwards, and stitched along their edges, as above mentioned; and then dipped into a solution of tin, whose oxide combines with part of the skin, and serves as a mordant for the colouring matter of the dye. According to Lalande, it is alum (that is alumine) which serves for a mordant; and he directs us to take twelve pounds of Roman alum for every eight dozen of skins. This salt is to be dissolved in about thirty (French) pints of hot water, and when the solution has become lukewarm, the skins are to be successively plunged into it, and be suffered to remain for a few moments; when they are to be drained, twisted, or wrung, and hung upon a horse, to remove all the folds from them.

The skins being thus mordanted by either of the above methods, and sometimes also by both of them, are ready to be dyed. In order to prepare the dyeing-bath, they take about ten or twelve ounces of bruized cochineal, according to the size of the skins, and dilute the cochineal with a sufficient quantity of water, to which they also add a little alum, or cream of tartar; they then boil the whole for a few minutes in a copper vessel, and then pass the decoction through a fine sieve, or, which is still better, through a fine linen cloth; they then divide this bath into two several portions, in order to give the skins two successive dips. They put the first half into a turning vessel, of a construction similar to that we have above described for washing the skins in, and then turn it eight or twelve dozen times; they are thus frequently agitated for about half an hour, when they renovate the bath by the addition of the other half of the decoction, and then proceed to give the skins a second agitation for the same time. When they are dyed, they are rinsed and tanned.

It may be here remarked, that the residuum of this dyeing bath, although it be not capable of communicating more than a very weak tint to the skins, is nevertheless not exhausted of its colouring matter, but still contains

abundance thereof; yet in such a state of combination, that the mordant fixed in the skins is not able to take it up readily; and this portion of colour has also less brilliancy. In order to extract the remainder of the colouring matter, the Morocco leather-dressers add to the residuum of the bath an excess of muriate of tin, or alum, which causes it to precipitate; and they sell this species of carmine lake, whilst still moist, either to the manufacturers of paper-hangings, or other persons.

The tanning of Morocco leather is ordinarily performed with sumach, at least in those countries where gall-nuts are too dear; and they give the preference to that which comes from Sicily, because it contains more tanning, and less colouring matter, than that from other countries, which is a great advantage in dyeing delicate colours. They usually employ two pounds of sumach for each ordinary sized skin; and two and a half, or three pounds for those of larger sizes. This operation is performed in a large vat, made of white wood, of a conical form, and which will hold from eight to ten dozens of skins; it is from fifteen to eighteen feet wide, in its greatest diameter, and five in depth. We may readily conceive that these large dimensions are necessary, when we know that the skins are extended like balloons, and that it is therefore not easy to manage them in the tanning. They fill this vat four-fifths high with water and sumach; they then take the skins, which had previously been sewn together along their edges, with their flesh-sides inwards, before tanning them, and make an opening at one end of them, in order to introduce within them, some sumach and water from the vat; they then tie these openings close with a packthread; and when they are all thus prepared, they are each turned or swung in the vats, by the power of two men in succession, for a quarter of an hour. At the end of this time they are removed, and placed upon a kind of bridge, which is fixed over the vat, in such a manner, that the water which drops from them, shall fall again into the vat. They are

thus filled and emptied twice in the space of twenty-four hours. When the operation has been well conducted, and the sumach is of a good quality, this time is sufficient for the tanning to be completed in; and when this is done, the skins are unstitched, rinsed, and beaten one or twice with the rammer's; they are then drained upon a table, by rubbing them all over with an *etire*, or an instrument formed of a blade of copper, whose edge is more or less rounded, and is mounted on a wooden block, with two handles to it, in a similar manner to the plate of stone above described, and termed the *querce*; and, lastly, they are hung up to dry.

When the manufacturers wish to enliven their red colour, when the skins are about half dry, they pass a fine sponge over them, which is moistened by a solution of carmine, made in ammonia. Others wet them with a decoction of saffron, which gives them a scarlet tinge.

When the skins are intended to receive other colours, they are tanned rather differently, and the methods vary in different places. At Marseilles, for instance, they put ten dozen of skins into a vat of about seven or eight feet in diameter, and which is made of white wood, with a proportionate quantity of water and sumach; these are turned about all day by four workmen, furnished with wooden shovels; in the evening they are taken out, and placed upon planks, supported over the vat; and when the sumach and water have drained from them, they are laid all night in clear water. This work is renewed during two or three days; but they do not turn them continually, and this time is sufficient to tan them in.

At Paris, they perform this operation in a kind of mills; these are barrels, placed horizontally, and traversed by an axis, with necks or pivots, upon which is fitted a pinion, which is driven by a toothed wheel, fixed upon another axis, with a winch or handle to it, and is worked by the power of a man. Into these mills the skins are put, with

the necessary quantity of water and sumach for tanning them, when they are agitated or turned for a sufficient length of time.

Other manufacturers prefer to tan their skins with gall-nuts; and they proportion the quantity of them, which they are obliged to use, according to the time employed in the tanning process, which may be from two to three months. For the rest, they follow the process employed at Marseilles. This is also the method which is followed in the Levant. There are many varieties of gall-nuts; the best are imported from Smyrna and Aleppo; but for tanning Morocco leather, they prefer those which are known by the name of *white-galls*, probably because they contain less colouring matter, and are therefore less likely to alter the beauty of the red dye. They employ about a pound of them for each skin. In this tanning process, they commence by mixing with cold water one half of the quantity of the pulverized and sifted galls necessary to be used; they then agitate the mixture a little, and also renew the stirring, when the skins are put in; in about an hour afterwards, they add the remainder of the galls, and suffer the whole to remain at rest for about two hours. They then incessantly stir the skins about for five hours with wooden shovels, and let them remain all night, but they take them out next morning, and after they have allowed them to drain a few moments, they are again put into the bath, and it is strongly agitated anew, to mix the component parts of it thoroughly; after remaining in the bath from fifteen to twenty hours, the operation is finished.

When the skins are tanned, they are cleansed with great care, in order not to hinder the application of the colours with which they are to be dyed. Thus they commence with rinsing them thoroughly; they are then well beaten with rammers in a vat with water; and finally, they give them a dressing on the flesh side, upon the horse, with a blunt-edged knife. After this first dressing, they are put

into lukewarm water, and they then give them a dressing on the hair side, with the *querce*, in order to clear the surface, and to soften it. When the skins are become less hard, they are again subjected to a third dressing, similar to the second.

At the time of dyeing the skins, they are again steeped in lukewarm water, and are then doubled and stitched together, with the hair-side outwards. They generally produce the colour at twice dipping.

Most Morocco leather-dressers dye their colours, with the exception of the reds, in small, long, and narrow wooden troughs; and they dip their skins at a temperature as high as the workman can bear; and which heat they continue, until they have obtained the required tint. When they have procured the degree of intensity which they wish, they remove the skins from the dye, and rinse them; they impregnate them with a little oil, to prevent them from being hardened in the air, and immediately hang them up, extended, in an airy drying loft; where, however, the rays of the sun cannot reach them; as, otherwise, the colours would suffer from the solar light.

As no colours but the red present any difficulty, and the skins readily take any dye, so we shall only summarily indicate the dyeing materials employed to obtain any desired colour.

*Black* is produced by impregnating the hair-side of the skins with a solution of acetate of iron, applied by means of a brush; this solution of iron is obtained by digesting old rusty iron scraps in stale or sour beer.

*Blue*.—This colour is dyed in a vat by the ordinary means. That is to say, the colouring matter of indigo is dissolved in the same manner as is practised by other dyers; nevertheless, a great number of Morocco leather-dressers give the preference to a vat, prepared with indigo, green copperas (sulphate of iron), and lime. This dye is made in the cold, and they give the skins more or

fewer dips, according to the tint which they would produce.

*Violet*.—This dye is given by one or two dippings of blue, which they afterwards glaze by passing the skins through a bath more or less charged with cochineal, agreeably to the colour they would obtain.

*Green*.—This colour is usually obtained by first passing the skins through a bath of Saxon blue, more or fewer times, according to circumstances ; and afterwards through one of yellow, by steeping the skins dyed blue in a decoction of barberry-roots, cut small, to which they also add a little alum, to serve as a mordant.

*Yellow*.—Is made by the above decoction of barberry-roots with alum.

It is easy to conceive, that with the help of these primitive colours, and by employing the proper mordants, we can compose all the others ; and which, indeed, result from the mere mixture of these first in various proportions. For instance:—

*Olive*.—To dye this colour, we first pass the skins through a dilute solution of green copperas (sulphate of iron), and then through a decoction of barberry-roots ; to which may be added, more or less of the solution of indigo, according to the intensity required.

*Solitaire* and *La Valliere*.—To obtain the dyes known by these names, the mordant is also green copperas ; and the skins are then passed through the same bath as is used to dye yellow with. We can obtain colours more or less deep, according to the relative proportions of the mordant, and the colouring material.

*Puce colour*.—This is made with a decoction of Indian-wood. With this dye we give two dips ; the first requires a little alum to be added, but the second is made without employing any mordant.

*Raisin de Corinth*.—If for the second bath of Indian-wood we substitute one of Brazil-wood, we shall obtain this dye.

*Greys.*—We can obtain all these tints by employing the black dye, the blue from indigo, and the red of cochineal ; they being used in convenient proportions : but the baths are always very weak.

Before dyeing all these tints, the skins are rinsed and wrung or twisted ; or, which is still better, worked and drained on a table by means of the *etire* ; and when they are dyed, the hair-sides of them should have a slight coat of linseed-oil applied all over them with a sponge, in order to cause the polisher to slide over them when they are subjected to the currying ; and in order also to prevent them from becoming hard by a too quick dessiccation when they are carried to the drying-loft.

The last work which is bestowed upon the skins is the currying ; this serves to bring out their lustre, and to render them supple. This operation is performed in various ways, according to the uses to which the skins are to be applied. For covering port-folios, pocket-books, knife and other cases, they are shaved as thin as possible on the flesh-sides ; are moistened a little, and are stretched upon a table, with the *etire*, in order that they may afterwards remain quite flat. They are then again removed to the drying-loft : or, otherwise, they may be again moistened and be passed three or four times through a grooved cylindrical press, in different directions, to cross the grain. Those skins which are to be used by shoe-makers, saddlers, book-binders, &c., require more suppleness, and are curried differently. When they are thinned, they are polished whilst a little moist, and a grain is formed upon the flesh side with the *pommelle*, used by the leather-dressers ; they are then glazed a second time to restore the lustre which the *pommelle* had destroyed ; and finally, they repair the grain on the flesh-side, by raising it slightly with a slice of cork affixed to a *pommelle* of white cork.

X.—*On the Advantages of early acquiring a Current or Running-hand at Schools.*

WE extract the following excellent observations from an anonymous work published in the year 1822, entitled, "Plans for the Government and liberal Instruction of Boys, in large numbers, drawn from experience."

"The most important branch of penmanship is undoubtedly the plain manuscript which we call running-hand. All the larger hands ought to be considered useful chiefly as they tend to give the pupil more just ideas of the forms of the characters, and more correct habits of delineating them, than he could gain by studying them in the minuteness of common manuscript. The large hand, seen through a diminishing glass, ought to be reduced into the current hand; and the current hand magnified, ought to swell into a large hand. But if this test be applied to any of the usual copper-plate copies, they fail. The large hands reduced appear very stiff and cramped when compared with the freedom of the running-hand; and the magnified running-hand, to those who have formed their task upon the models in general use, appears little better than a scrawl.

"Perhaps this want of proportion results from a wish to make each hand perfect of itself. The artists may be of opinion that the same proportional width is not necessary in the larger hands as in the smaller ones. And this opinion is probably a correct one; but then, *as the larger hands are but seldom used in real life, the power of writing them, even in their most perfect state, would be dearly bought at the expense of the current hand!* In the common methods of instruction a current hand is rarely acquired at school, even at any age. With us, *it is a point of great importance to put the pupil in possession of so useful an instrument of education, comparatively early; and, therefore, if any sacrifice were necessary for the attainment of this end, we should be ready to make it; but no sacrifice is demanded.*

When the running hand is acquired, the pupil may, if it be thought necessary, learn to write the larger hands, according to the received models ; but until he has accomplished what appears to us to be the object of greatest importance, we are unwilling to perplex his ideas and his incipient habits with inconsistent exemplars and various modes of execution.

“ The requisites of a running hand are three : legibility, rapidity, and beauty. These are placed in what we conceive to be the order of their value.

“ As the use of writing is to be read, no manuscript which has not a fair degree of legibility can be called good ; and the writer, in judging of the degree requisite, should recollect, that his own hand-writing must be more familiar, and of course more legible, to himself than to others.

“ That the power of writing swiftly is of great importance will be readily conceded. The labour which is so frequently undergone to acquire a short-hand, proves that much inconvenience is already suffered from *the slowness which the present cumbrous system of our orthography, and the complicated structure of our written characters*, impose upon the writer, to render any additional clog from want of dexterity in himself at all tolerable.

“ The beauty of manuscript it would be very difficult to reduce to principle ; perhaps it would be impossible to show one, very swiftly written, and very legible, which was not beautiful. At all events, we conceive the writer would have but little reason to lament any deficiency in a hand which possessed two such valuable qualities.

“ The usual method of instruction in penmanship is to commence by teaching the pupil to imitate an example of large hand, which has the defect beforementioned, of not being a correctly magnified running hand. Thus his ideas of excellence are injured ; but that is not all ; for setting aside the incorrectness of the model, the scholar is permitted to gain a habit of forming the letters which he has to unlearn when he begins to write swiftly. He is ge-

nerally allowed to raise his pen, and remove his hand at every stroke ; nor does he set his pen down at the precise point at which he raised it ; for supposing him to have finished a down-stroke, he springs the following up-stroke, not from the foot of the stem, but from the middle ; so that, instead of *preserving one uniform gliding motion to the end of the word, in which neither the hand nor the pen is ever removed from the paper*, the pupil is learning a system of double-leaps,—one horizontal with his hand, another oblique with his pen.

“ We no more see, we must confess, how the scholar can learn a running-hand by such practice as this ; than how he could learn to skate, by imitating the jumping of a frog ! In fact, he does *not* learn a current-hand by any such process ; and nothing is more common than to find a boy, who brings home copy-books beautifully written, fall into a wretched scrawl the moment he attempts an approach to the rapidity of real business. If he possess a natural facility for acquiring the art, he may do so by practice, after he has left school ; but if he be the mere creature of instruction, he continues to scrawl through life. Thus we consider the manner in which a letter is formed, to be of more importance than its abstract beauty or deformity ; for who could hesitate to prefer the power of writing a plain but rapid hand, to that of producing the most exquisite caligraphy at so slow a rate as to be unfit for business ?

“ It is not our intention to enter into a detail of our plan. If the intelligent reader agree with us in our principles, he will easily conceive that means may be found to carry them into effect.”

*Remarks by the Editor.*—We entirely agree in these judicious remarks, and must ever lament the great waste of time occasioned in our schools by the general methods of teaching the art of penmanship. Our own experience has convinced us, that this most invaluable accomplishment, a *current or running-hand, may be acquired at once*, and without that tedious preparation which the pupil undergoes

in the ordinary practice. We know two different instances of children at the age of twelve years, *learning to write a running-hand on the principles alluded to*, and rather as an amusement than a task, *in the short period of three months*, and yet not taking more than two or three lessons in each week ! Now, surely, if this valuable art is to be acquired in this speedy and pleasant manner, how very erroneous must the present tedious system of teaching it be, and how highly necessary is it to adopt other methods of far greater efficacy and dispatch. For, indeed, until a good current-hand is acquired, the pupil makes but little progress in arithmetic, and the other branches of useful science.

Possibly these two children acquired the art of writing a running-hand with such facility from their never having been taught to write at all, by the ordinary means ; and, consequently, they had nothing to unlearn.

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IX.—*On the Art of the Liquorist\**.

THE term *liquorist* is given to the preparer of *liqueurs* for the table, and which are composed of alcohol, water, sugar, and different aromatic ingredients. Since the valuable discovery in distillation, made by Edward Adam, a total change of system has been effected in the manipulation of the distillers of brandy and other spirits ; and the liquorist now assumes the title of *distiller-liquorist*, because he is necessitated to re-distil brandy, in order to transform it into spirits fit for his purpose. Whereas, formerly the distiller always furnished the rectified alcohol to the liquorist. We shall now proceed to give the necessary information to enable persons to obtain excellent products.

The liquorist extracts the perfumes from the various aromatics which he employs : first, by infusion, and then by

\* From the *Dictionnaire Technologique*,

distillation The liquor in which he infuses them, varies according to their nature ; but it is the alcohol known in commerce, under the name of *thirty-six and a half degrees\**, which he employs ; and either pure, or mixed with an equal measure of river water, or other pure water, when it is termed alcohol of eighteen degrees.

*Infusions of fruits or rinds.*—With a very sharp knife, he peels off the outside rinds, in thin morsels, in order that they may the more readily yield the essential oils which they contain. These are let fall into a glazed earthen vessel, containing alcohol of 36°, diluted with an equal volume of water, and which must afterwards be securely closed ; but when he would employ the fruits themselves, he puts them into large bottles, made of white glass, and which must also be well closed. In either of these modes he thus prepares the infusions of citrons, oranges, lemons, shaddocks, *bergamottes*, &c. These are left to infuse during six weeks, frequently shaking the vessels from time to time, and are finally distilled.

*Infusions of seeds.*—The aromatic seeds, after being previously bruised or pounded, must be put into large glass bottles, well closed, together with alcohol, diluted with an equal portion of water ; they must be shook up from time to time, during the space of six weeks, and be then distilled. In this manner the seeds of fennel, anise, cloves, dill, &c., are prepared. But as the seeds of celery, and angelica, contain an essential oil, which is too acrid when prepared in the above manner ; so they employ the stems of those plants instead thereof.

*Infusions of aromatic woods.*—These are either to be pounded, or to be cut into minute portions ; and they add a few drops of water to them, whilst pounding them, to retain them the better under the pestle. These are to be infused and distilled, in the same manner as the seeds.

*Solutions of aromatic rosins.*—Myrrh, aloes, storax, and

\* Of Beaume's Areometer, equal to about 0.8500. specific gravity.

others, which form the basis of elixirs, likewise enter, in small quantities, into the composition of certain *liqueurs*, when dissolved in pure alcohol of 36°. These solutions should not, however, be more than slightly charged therewith, lest they become too acrid.

It is easy to conceive that the warehouse of the liquorist should be furnished with proper shelves, &c., on which the vessels which contain the great number of various infusions he requires, should be placed always ready for use. Each of the vessels should bear a label, indicating the nature of the infusion which it contains; and also, whether the infusion has been made with alcohol alone, with the diluted alcohol, or with water only, as is the case with flowers, before submitting them to distillation. When the maceration has been sufficiently prolonged, we proceed to a careful distillation. The products of each distillation must be likewise preserved in similar large and well-closed bottles, and bear the name of *spirit*, as *spirit of citron*, *spirit of aniseed*, &c.

The liquorist who is anxious to manufacture excellent *liqueurs*, never adds the colouring materials to them, until six months has elapsed after their distillation. He suffers that time to elapse, in order that the perfumes may be well combined with the alcohol. If, nevertheless, he is obliged to employ them in a short time afterwards, as, in the course of a few days for instance, he then takes care to shake up the vessels more frequently every day, in order to hasten their combination:

*On the composition of liqueurs.*—The *liqueurs* are designated by different names, according to the manner in which they have been manufactured. They are thus termed *waters*, *creams*, or *oils*. The *waters* are those *liqueurs*, which do not present any viscosity to the taste. The *creams*, or *oils*, appear to possess those properties, on account of an agreeable species of viscosity which they afford in the mouth. The same *liqueur* may be made to possess either the first quality or the second, at will by

merely changing the proportions of the perfumes, or other ingredients employed. An example or two will enable us to understand the difference.

*Cedrat-water.*—Three kilograms of white sugar are to be dissolved in eight litres of river water; then add two litres of *spirit of cedrat*, and one litre of *spirit of citron*; make the whole boil for a minute, and filtre it, while hot, through a straining-bag (*chausse*); receive the liquor into a vessel of earthenware, and change the vessel as soon as it no longer passes clear. When it becomes cold, put it into large bottles, and do not open them until a considerable time afterwards.

*Oil or cream of cedrat.*—Eight litres of river water, two litres of *spirit of cedrat*, and add as much syrup of sugar as will soften the *liqueur* to the necessary degree, to give it a clammy consistence; then agitate or stir it well with a *spatula*, to make the combination perfect, and put it into bottles, which must remain for a considerable length of time unopened. If the *liqueur* should become a little turbid, it must be filtered through paper, or better through a filtre made of fustian, suspended in a funnel of tinned sheet iron, closed by a moveable cover.

We see, by these two examples, that the difference between the *waters* and the *oils*, consists in employing more or less sugar. When we use the sugar in its entire state, and but in small quantity, we form the *waters*; but when we employ it in the state of syrup, and increase the proportion of it, we obtain a viscous *liqueur*, and which appears oily both to the sight and taste.

Our limits will not permit us to give recipes for making all the kinds of *liqueurs*; but they may be found in several works which treat on the art of the liquorist; we shall merely give the leading outlines of this art.

(To be continued.)

## LIST OF PATENTS FOR NEW INVENTIONS,

*Which have passed the Great Seal since Nov. 27, 1828.*

To William Godfrøy Kneller, of Great Pearl-street, Spital-fields, in the county of Middlesex, chemist; for certain improvements in evaporating sugar, which improvements are also applicable to other purposes. Dated Nov. 27, 1828.—To be specified in six months.

To Joseph D'Arcy, of Leicester-square, in the county of Middlesex, esq., sole executor and residuary legatee of Charles Broadrip, late of Spring-gardens, in the parish of St. Martins in the Fields, in the county of Middlesex, esq. deceased; for certain improvements in the construction of steam engines, and the apparatus connected therewith. Dated Nov. 29, 1828.—In eighteen months.

To Edward Dakin Philp, of Regent-street, St. James's, in the county of Middlesex, chemist; for an improved distilling and rectifying apparatus. Dated Nov. 28, 1828.—In six months.

To Robert Stein, of Regent-street, Oxford-street, in the county of Middlesex, gentleman; for certain improvements in distillation. Dated Dec. 4, 1828.—In six months.

To William Brunton, of Leadenhall-street, in the city of London, civil engineer; for a machine, apparatus, or instrument to ascertain and register the quantity of specific gravity and temperature of certain fluids in transit, part or parts of which invention is or are applicable to other purposes. Dated Dec. 4, 1828.—In six months.

To Philip Derbshire, of Ely-place, Holborn, in the county of Middlesex, esq.; for a certain medicine or embrocation to prevent or alleviate sea sickness; which may be usefully applied to other maladies. Dated Dec. 4, 1828.—In six months.

To Zachariah Riley, of Union-street, Southwark, in the county of Surrey, engineer; for a certain improved apparatus to be attached to carriages, for the purpose of affording safety in travelling. Dated Dec. 10, 1828.—In four months.

To George Rennoldson, of South Shields, in the county of Durham, miller; for certain improvements in rotatory steam engines. Dated Dec. 4, 1828.—In two months.

To John Hague, of Cable-street, Wellclose-square, in the county of Middlesex, engineer; for certain improvements in the method of expelling the molasses or syrup from sugar. Dated Dec. 6, 1828.—In two months.

To Isaac Dickson, Chester-street, Grosvenor-place, in the county of Middlesex, esq.; who, in consequence of a communication made to him by a certain foreigner residing abroad, and discoveries by himself, is in possession of an improved projectile. Dated Dec. 8, 1828.—In two months.

To John Boase, of Albany-street, gentleman; and Thomas Smith, merchant, of Augustus-street, both in Regent's Park, in the county of Middlesex; for certain improvements in machines or machinery, <sup>for</sup> scraping, sweeping, cleaning, and watering streets, roads, and other ways; which machines or machinery may also be applied to other purposes. Dated Dec. 10, 1828.—In two months.

To Thomas Lawes, of the Strand, in the county of Middlesex, lace manufacturer; for certain improvements in the manufacture of bobin net lace. Dated Dec. 10, 1828.—In six months.

To Charles Cummerow, of Lawrence Pountney-lane, Cannon-street, in the city of London, merchant; who, in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of certain improvements in propelling vessels. Dated Dec. 10, 1828.—In six months.

To Abraham Lewis, of Dean-street, in Birmingham, in the county of Warwick, mechanic; for a mechanical *volti subito*, to assist the player of music quickly to turn the leaves of music books whilst playing. Dated Dec. 10, 1828.—In two months.

To Samuel Jones, of the Strand, in the city of Westminster, and county of Middlesex, artist; who, in consequence of a communication from a foreigner residing abroad, is in possession of a new and improved method of producing instantaneous light. Dated Dec. 10, 1828.—In two months.

To Thomas William Charming Moore, of the city of New York, in the United States of North America, now residing at Hampstead, in the county of Middlesex, merchant; who, in consequence of a communication from a foreigner residing abroad, is in possession of an improved method, or combination of machinery, for manufacturing hats or caps. Dated Dec. 10, 1828.—In six months.

To Valentine Llanos, of Hampstead, in the county of Middlesex, gentleman; who, in consequence of a communication from a certain foreigner residing abroad, is in possession of an improvement or improvements on bits. Dated Dec. 15, 1828.—In six months.

To John Forbes, of Cheltenham, in the county of Gloucester, architect and surveyor; for a method of burning or consuming smoke. Dated Dec. 15, 1828.—In six months.

To Richard Williams, of Tabernacle-walk, in the county of Middlesex, engineer; for certain improvements in the application of elastic and dense fluids, to the propelling of machinery of various descriptions. Dated Dec. 15, 1828.—In six months.

To Anton Bernhard, of Finsbury-circus, in the county of Middlesex, engineer; for certain improvements on, or additions to, wheels, or apparatus for propelling vessels, and other purposes. Dated Dec. 15, 1828.—In six months.

To John Dicken Whitehead, of Oakview Mills, Saddleworth, in the county of York, woollen manufacturer; for certain improvements in making, constructing, or manufacturing cartridges, for sporting and other purposes. Dated Dec. 15, 1828.—In six months.

To John Morfitt, of Cockridge, near Leeds, in the county of York, bleacher; for a certain improvement in retorts used by bleachers, and makers of oxymuriatic acid, or oxymuriate of lime. Dated Dec. 15, 1828.—In two months.

To John Slater, of Birmingham, in the county of Warwick, manufacturer of coach springs, and axletrees; for certain improvements in axletrees, and the boxes for carriage-wheels. Dated Dec. 15, 1828.—In six months.

To John Levers, of the town of Nottingham, machine maker; for certain improvements in machinery for making the lace commonly called bobbin-net. Dated Dec. 18, 1828.—In six months.

To William Stead, of Gildersom, in the county of York, Millwright and machine maker; and James Stead, of Doncaster, in the same county, wood valuer; for a paddle wheel upon a new or improved principle, for propelling steam packets, and other vessels. Dated Dec. 18, 1828.—In two months.

To Joseph Charlesworth, and Joshua Charlesworth, of Holin-

firth, woollen manufacturèrs, and merchants; and Samuel Andrew Mellor, of the same place, cloth dresser, all in the county of York; for certain improvements on, or additions to, gig-mills, for the raising and finishing of woollen cloths and other fabrics. Dated Dec. 18, 1828.—In two months.

To James Simister, of Bull-street, Birmingham, in the county of Warwick; for improvements in weaving, preparing or manufacturing a cloth or fabric, and the application thereof to the making of stays, and other articles of dress. Dated Dec. 18, 1828.—In six months.

To Edward Joseph, of Haydon-square, Middlesex, merchant; for certain improvements on the wheels, axletrees, and other parts of carts, waggons, and other conveyances. Dated Dec. 18, 1828.—In six months.

To Francis Horatio Nelson Drake, of Colyton-house, in the county of Devon, esq.; who, in consequence of a communication made to him by a foreigner residing abroad, is in possession of a process for a peculiar till. Dated Dec. 18, 1828.—In four months.

GILL'S  
TECHNOLOGICAL & MICROSCOPIC  
REPOSITORY.

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XII.—*On the Microscope.* By the EDITOR.

WITH A PLATE.

(*Continued from page 8.*)

*Additional particulars of the mixture of Salts, termed by the Editor the "Microscopic Kaleidoscope."*—The Editor has lately added a fourth salt to the three originally forming this mixture; and which, whilst it has rendered the configurations produced by it under the microscope sufficiently permanent to allow of their being seen by different persons in succession, and to be copied by the artist, has likewise considerably improved their beauty.

This mixture still holds its original constituents, namely, the boracic, tartaric, and muriatic acids; and the three alkalies, potash, soda, and ammonia; but their proportions are changed by the addition of this fourth salt.

In plate II. figs. 1, 2, and 3 represent three of these configurations, in the exact positions they appeared in under the microscope. The two first of them are elegant variations of hexagonal figures, interspersed with six leaved flowers, and foliage; and the third figure is composed of rhombs.

Fig. 4 is nearly a regular equilateral hexagon on five of its sides, the sixth being open to permit the passage of a secondary series, which take their rise in the middle of the primitive hexagon; and frequently figures are formed which are thus constructed, and even more complicated, still.

however, preserving their original structure, whether hexagonal, rhomboidal, or rectangular.

Fig. 6 is a configuration, the general outline of which is an ellipsis, and is formed of six rays, proceeding from one centre, and filled up between them with hexagonal ramifications.

Figs. 7 and 8 are two other configurations, formed of four rays each, proceeding from one centre, at right angles, and filled up between them with parallel lines; but in quite contrary inclinations with respect to the primitive rays.

Figs. 9 and 10 are two hexagonal crystals which occasionally form in the drop of fluid. Fig. 9 resembles a cube, posited on one of its corners; and fig. 10 the same; but, wanting a sufficient depth of fluid to complete its upper surface, it is terminated by an equilateral triangle.

Figs. 11 and 12 are two square crystals, also frequently seen in the same drop with the two preceding ones. Fig. 11 has two lines along it, parallel to two of its sides; and fig. 12 two others, crossing its centre at right angles.

*On the pectinated Mite.*—We believe that this rare species of mite has only been figured and described by the late celebrated Dr. George Shaw, of the British Museum, in his work on Insects. Mr. C. Gould has lately found it amongst the dust sifted from poppy-seeds, and has favoured the Editor with several living specimens of it, from a microscopic examination of which he has been enabled to furnish the following particulars.

This mite has two stout parts, which proceed from its head, one on each side, like arms, and each part is furnished, at its exterior extremity, with a sharp fang, and two toothed appendages like combs, from whence it derives its name. With this apparatus it seizes its prey, and conveys it to its mouth, and also employs it to great advantage whilst devouring it.

Each of its eight very slender legs are terminated with feet, furnished with four exquisitely shaped claws; which

can be distinctly seen, under the power of a single lens, the twentieth of an inch focus, in our Varley's microscope; as well also as the numerous joints, by which they are connected with the legs.

It now appears that it was this exceedingly curious species of mite which furnished our valuable contributor, Mr. Thomas Carpenter, with the specimens of the teeth of the mite, engraved and described in our second volume, page 148; but as, in placing the mite between two slips of thin plate glass, he had crushed it, and entirely destroyed the figure of the adjoining parts; so it was impossible to determine their connection with the teeth. He has since sought for similar objects amongst the ordinary mites, but we need not now say in vain, they not being furnished with them.

It is our intention, in a future number, to afford magnified figures of this curious insect; which, however, is no larger than the common mite, although it preys upon them and other minute insects, which it finds amongst the poppy-seeds.

*On the ten eyes and fangs of an African spider.*— We mentioned this curious insect in our last number, page 8. We are now, through the kindness of our friend, Mr. T. Carpenter, enabled to afford our readers a magnified figure of its head, eyes, and fangs, in our present plate, fig. 13; and in which the four eyes, forming a cluster in the middle of the fore part of its head, are distinctly shown; as well as four others, two of which are affixed on each side of the two external parts, or protuberances, which are placed at the front of its head, and thus enable it to see sideways. And the two eyes, which complete the number ten, will be seen, as posited in the hinder part of its head.

Its two powerful fangs and teeth are also shown in our figure.

The head is black, but is occasionally sprinkled over with white hairs. The object was drawn as viewed in

Mr. T. Carpenter's excellent opaque compound microscope.

*On the piercing apparatus of the stomoxis calcitrans ; and on the tongue of the domestic fly.*—In plate II, figs. 14 and 15, represent the upper and under views of a black and curiously articulated sheath, with which the head of the stomoxis is furnished, and which appears to be capable of being contracted or extended, like the trunk of an elephant. Fig. 14 represents the upper side of this trunk, and fig. 15 its under side, which has a groove along it, in which the two piercing and sucking instruments, shown in fig. 16, can be occasionally lodged. The larger of these is in a conical form, but its end is suddenly terminated by an exceedingly sharp point. The slenderer of these two instruments seems better adapted to perform the office of irritating the wound made by the stronger one, than to inflict one itself. The surface of the larger instrument is covered with minute scales, pointing forwards ; and the cleft exterior end of the sheath is furnished with teeth, formed like the points of lancets, as shown in fig. 17, which is a highly magnified view of this part. With this formidable apparatus, this noxious insect is enabled to inflict the *painfully severe wounds* so ably described by Mr. T. Carpenter, in his article on this and other insects, contained in our present number ; and, as the stomoxis so exactly resembles our domestic fly in other respects ; so it, unfortunately, is often confounded with it ; and is often made to suffer for the agonies occasioned by the bites of the stomoxis. The house fly is indeed furnished with a *tongue of the most exquisite structure*, which proceeds from its throat, but with which it is utterly incapable of inflicting any wounds.

Fig. 18 of plate II. represents a magnified view of the tongue of the domestic fly, as extended or protruded from its mouth ; and fig. 19 is a still more enlarged view of the exterior end of it, to show its admirable and beautiful structure.

This tongue had been prepared by Mr. T. Carpenter, by steeping it in water for some hours, in order to swell it out, and thus exhibit its formation the more distinctly. The edge of the exterior end is seen in the side view of it, fig. 18 ; but its peculiar structure is best shown in the enlarged front view of it, fig. 19 ; where the numerous rows of raised and rounded parts are shown, with double dotted lines arranged along the depressions between the ridges. This object is shown as opaque, and as seen in Mr. T. Carpenter's compound microscope. But we hope, at some future period, to be enabled to furnish a figure of it, viewed as a *transparent object*, when its truly wonderful and complicated structure will be rendered still more apparent.

*On the eyes of the insect termed the julus, or craspedosoma polydismoide.*—This is a British species of scolopendra, with numerous legs ; and, when placed on its side, and viewed as an opaque object, in Mr. T. Carpenter's compound microscope, one set of its eyes presented the curious arrangement shown in fig. 20, of plate II. The uppermost row consisting of seven eyes, the next of six, and each row decreasing one in succession, until the set ends with a single eye only, and the whole forms a triangular figure. Each eye is completely separated from the others, and does not form part of a continued combination, as is usual in the eyes of insects.

*On the singular structure of the cornea of the eye of a haddock.*—If the cornea of one of these eyes, after being boiled, be dried, it will be found to be composed of a vast number of concentric layers, which may be separated like the coats of an onion. When one of the thinnest of these layers is viewed as a transparent object in the microscope, it will be found to contain numerous parallel rows of lines, each line being formed of zig-zags, or wavy lines, as endeavoured to be shown in fig. 21, plate II. ; and which evidently form a kind of sutures, admitting of a degree of motion to take place amongst them, by which the cornea of this fish's eye may

be enlarged or contracted, or its figure be changed, so as to accommodate its vision, according to circumstances.

*Additional particulars on the animalculæ which inhabit the shells of the eggs of the wheel-animalculæ.*—In our last number, page 6, we described this animalculæ, as seen by us, when placed in the egg, upon the surface of the leaf of an aquatic vegetable, and gave a figure of it in figure 10, of plate I. Since then, we have been highly gratified by seeing it protrude its apparatus into the water surrounding the leaf; and observing the motion it causes in the water, in order to bring minute animalculæ within its reach. Fig. 22, of plate II. represents this apparatus, consisting of a singularly curved stem, from which numerous fibrillæ proceed, as shewn in the figure; and it occasionally withdraws, and again protrudes, this apparatus, from time to time. We again give the representation of the animalculæ in the shell of the egg, in order to afford a complete view of the whole. It requires an excellent microscope to distinguish the minute fibrillæ: our Varley's single microscope has, however, enabled us to discover and delineate them, as represented in our figure.

*On the piercers of the flea which preys upon human beings.*—In our last number, page 5, we described the apparatus employed by the flea. Since then, we have been favoured, by Mr. T. Carpenter, with a sight of another flea, in which the piercers are each provided with four rows of bead-like threads, two on each side, as shown in fig. 23, of plate II. and which are twisted around each other in the manner there represented. Between one set of them and the solid part of the piercer, on its left side, a complete separation is shown; so that there can no longer remain any doubt of their being distinct parts from the piercers.

The piercers of the flea exhibited in our former plate are described as being serrated along their edges. Mr. T. Carpenter informs us, that it was one of the fleas which he found upon his dog; and he thinks it not unlikely that it may differ from those which feed upon the human subject,

both in this as well as in other respects. He has a flea taken from a mole, which entirely differs in shape from either of the abovementioned ones.

*On the caterpillar in the egg of the flea.*—Mr. T. Carpenter has recently favoured us with a sight of several of these eggs, mounted as transparent microscopic objects, and in which the caterpillars are plainly to be distinguished, lying as shown in fig. 24, of plate II.

*On air-holes in the ends of the eggs of fleas.*—We have, amongst our numerous transparent microscopic objects, one of the eggs of a flea, placed between two slips of plate-glass, and in which several circles of holes may be seen, at each end of the egg, similar to those shown in fig. 25, of plate II.

*The late Dr. Wollaston's opinion on the compound eyes of insects, and the crustaceous animals.*—In our second volume, page 193, we stated, that Mr. T. Carpenter had shown the curious microscopic preparations he had made of these compound eyes to several of our most eminent men in the world of science, last spring. Mr. Carpenter has since informed us, that one of these gentlemen was the late lamented and highly scientific Dr. Wollaston; and who, after viewing the preparations, was so much struck with surprise at the numerous plates or lamina, full of distinct lenses, forming each eye of a cray-fish; and also with the tubes attached to each lens of their inner lamina, that he proceeded to measure, by a particular method of his own, the focal distance of those lenses, and which he found exactly agreed with the length of the tubes. He then pronounced his opinion to be, that Mr. Carpenter had completely established the fact, that they were really eyes, answering the purposes of such organs. The method which Dr. Wollaston took to satisfy himself was so satisfactory to the scientific friends who accompanied him, that they also fully assented to his opinion.

Mr. Carpenter's memorandum of this occurrence is as follows :—

"On Friday, Feb. 22, 1828, I exhibited under the microscope, to Dr. Wollaston, and two other eminent gentlemen of science, sections, &c. from the eyes of cray-fish. Dr. Wollaston, in order to satisfy himself and his friends that they were eyes, measured the length of the tubes, and then the focal length of the lenses in the cornea, by which means he found that the focal length of the lenses was precisely the same as the length of the tubes. Thus they were not only satisfied that they were eyes, but that the construction of these eyes was upon the principle of telescopes; as the image of any object would be formed at the bottom of each tube, upon a lens or humour in the divisions in the retina, similar to that formed in the eyeglass of a telescope, and be from thence conveyed to the organ of seeing in the brain."

*On the scales of the insect termed the lepisma saccharina.*—Dr. Hook, in his "*Micrographiæ*," has given a figure of this insect, which, however, he terms the clothes-moth, in its worm-state. It is, nevertheless, a perfect insect.

This insect is covered with scales, one of which we have represented in fig. 26, of plate II. as drawn from one in the possession of Mr. T. Carpenter. It is very ragged on its edges, and is connected with the body of the insect at the hollowed part, shown in the lower part of the scale; and not by a kind of stem, as in most of the scales or feathers of moths, &c. The lines or furrows along it, are closer together at the lower part of the scale than at its upper part.

*On the scales of the maritime podura.*—This insect was presented to Mr. T. Carpenter, by Mr. Children, of the British Museum, who caught it on the coast of Sussex.

Its scales are furrowed with parallel lines, as shown, on a highly magnified size, in fig. 27, of plate II. and its upper end is terminated in the singular manner shown: namely, being apparently broken away on the sides. The exact correspondence of its shape, however, on each side,

would seem to contradict that opinion. Others of the scales are terminated differently; still, however, preserving an exact resemblance on each side of them.

This scale was affixed to the body of the insect by the appendage shown in the middle of its lower part.

*On a feather or scale of the butterfly, bred upon the brassica rapi.*—This feather is one of the *test objects* selected by Mr. T. Carpenter for trying the perfection of microscopes. It is shown in fig. 28, of plate II. The feather is attached to the wing of the butterfly by means of the small circular appendage, which is shown in the middle of the forked part of the feather; and not, as might be supposed, by the ragged part at its upper end.

*On the feather or scale of the butterfly bred upon the brassica rapæ.*—This is another of the *test objects* selected by Mr. T. Carpenter, and chiefly differs from the one last mentioned in being of a slenderer make. It is affixed to the wing of the butterfly by the small circular appendage shown as lying upon one side, and above the gap in the lower part of the feather, as exhibited in fig. 29, of plate II. The longer feather of a *papilio brassica*, or large white garden butterfly, shown in fig. 5, plate IV. of volume III. is, however, a still more difficult test object.

*On a singular feather or scale of the lycena agrolus, or azure blue butterfly.*—This insect has several different kinds of feathers upon its wings and body; but the most singular one, is that shown in fig. 30, of plate II. and which is drawn from a specimen in Mr. T. Carpenter's extensive collection of transparent microscopic objects.

Its appearance does not greatly differ from that of a cut glass goblet without its foot, so strangely is it shaped and marked by lines, and rows of spots, in the manner shown in our figure. It is affixed to the insect by the stem at its lower part.

*On rheum as a microscopic object.*—This humour has already been pointed out by Baker, in his work entitled "Employment for the Microscope;" and as there can be

no difficulty in obtaining plenty of it in the winter season, when so many persons are affected with running colds, so we recommend to our readers to procure a drop of it, and suffer it to form its curious configurations upon a slip of glass; and afterwards, to secure it from injury, by cementing another slip of glass over it, when it will form a permanent and beautiful transparent object for the microscope.

These configurations very much resemble some of those we have already figured in plate IV. of volume II. as being produced from a solution of muriate of soda (common salt) in various viscid mediums, and are, therefore, most probably formed from the salt which is so plainly perceptible in the rheum of running colds.

*On crystallized gold as a microscopic object*—The Editor has, in his collection of opaque objects for the microscope, two, which he purchased, as being specimens of native gold; they are of a foliated shape, and one of them is covered with crystals, some of which are in the form of equilateral triangles, terminated with three facets, meeting in the centre of each; others are differently formed. The other object is also crystalized, but not so regularly as the former one. Mr. John Cuthbert lately showed him similar specimens of foliated and crystallized gold, of an appearance resembling his own, but he said they were not native gold, but the product of art; and that he could prepare such in a short period of time. However this may be, the Editor has in his own possession a beautiful specimen of crystallized gold, abounding in brilliant hexagonal crystals, which has formed itself, in a long course of years, from an ethereal solution of gold, kept undisturbed; and has deposited itself, in the circular depression, at the bottom of the closed phial containing it, and has thus taken the shape of a tolerably coherent ring of fine gold, studded with the brilliant crystals above-mentioned. The other specimens have a dead or dull appearance, such as would be produced from the evaporation

of the mercury, by heat, from an amalgam of gold ; and they may, very possibly, be thus produced.

*On the arborizations of silver under the microscope.*—

Mr. T. Carpenter recently favoured the Editor with a sight of these, produced by spreading a solution of silver in the nitric acid, upon the surface of a slice of ebony, and sprinkling a few filings of brass in the drop, when the arborizations instantly commenced shooting under his eye, and appeared of a beautifully white colour, and a most exquisite structure when viewed as an opaque object, and illuminated by the light thrown upon them from his silver speculum. He likewise spread more of the solution upon a slip of glass, when the Editor had the pleasure of viewing it as a transparent object, the ramifications then appearing in minute black lines, and still better defined, than when viewed as an opaque object. Mr. Carpenter, however, enabled him to view the same preparation as an opaque object likewise, by placing a blackened slip of card underneath the glass slip, and illuminating the object by means of the speculum, as in the former case. In either of these ways it forms a most beautiful microscopic object, and ought to be more frequently seen than is the case in general.

*On viewing the crystals of sugar in the microscope.*—

If a solution of white sugar be made in spirit of wine, in a small phial, by heating it, on cooling, it will deposit beautifully transparent and well formed crystals, around the interior surface of the phial, well calculated for forming objects for the microscope ; and which may be preserved for any length of time, by carefully closing the mouth of the phial. In this manner the Editor prepared such, as microscopic objects, many years since.

*Additional particulars of the suckers upon the feet of the dytiscus, or large water beetle.*—We extract the following remarks from Kirby and Spence's excellent work on Entomology, vol. III. page 694 :—“ But the genus that exhibits to the curious entomologist the most singular and

elaborate apparatus of this kind, is dyticus, and the examination of the under side of the *hand* of any *male* of this genus, will almost compel the most inattentive observer to glorify the wisdom and skill of the Almighty, so conspicuously manifested in the structure of these complex organs. For this part in these, instead of two or three pedunculate cups, as in many other insects, is composed of vast numbers, some large, and some small. If you take a small specimen of the common *dyticus marginatus*, you will find that the three first joints of the hand are very much dilated, so as to form a plate or shield, nearly circular, fringed all around with stiffish hairs: if you next examine the under side of this plate with a good magnifier, you will discover at the base, where it is united with the cubit, two circular cups, the external one more than three times the size of the other, with an umbelicated centre; besides these two larger cups, the rest of the shield is covered by a vast number of minute ones, of a similar construction: the larger cups are nearly sessile, but the smaller are elevated upon a tubular footstalk: the three first joints of the intermediate tarsi are also dilated, but not into an orbicular shield, and thickly set with minute pedunculated suckers."

Our former notice on this wonderful apparatus will be found in vol. II. page 141.

*On the internal parts of the insect termed the staphelinus.*—Mr. T. Carpenter recently favoured the Editor with a sight of his admirable display of the internal parts of this insect, viewed as an opaque object in his compound microscope, when the blood-vessels, the muscles and tendons, and, in particular, the blind-gut, were most distinctly seen, although the preparation had become quite dry. In its recent state, and while the parts retained their perfect structure, and had not shrank in drying, Mr. Carpenter said that it formed the most exquisite object he had ever witnessed; and, from what the Editor saw, he believes that it must have been so.

*On the ticks which infest the staphalinus.*—Mr. T. Carpenter has lately shown the Editor a *staphalinus* as an opaque object in his microscope, which has its body partly covered with a curious species of scarlet ticks, whose backs are armed with plates, curiously connected together, much like those of the tortoise. These ticks form highly interesting microscopic objects.

*On the intestines of a bee, preserved in spirits of wine, as a microscopic object, by Mr. HOLLAND.*—This beautiful preparation, made in the month of September last, still preserves its perfect forms, the spirit having but very slightly indeed escaped from it, for a period of nearly five months! This valuable circumstance could hardly have been anticipated, when the specimen was originally put up by Mr. Holland, although he expected that it would continue perfect for a much longer time than in any previous mode of preparing microscopic objects.

We stated, in our number for December last, that Mr. C. Gould had adopted Mr. Holland's excellent method of thus securing transparent objects for the microscope; and we have since then seen several very beautiful ones of his preparing. Our microscopic readers must, with us, have continually lamented the perishable nature of our delicate preparations; but now we have an opportunity of rendering them permanent.

We shall continue to notice, from time to time, the state in which Mr. Holland's preparation remains with us. It has now, however, more than realized our expectations of it; the blood-vessels still preserve their beautiful and graceful forms, ramifying over the surfaces of the stomach and other intestines, as at first; the grains of the farina of the mallow, upon which the bee was feeding when caught, are still distinctly visible in its stomach; and, in short, it has lost hardly any thing of its pristine excellence.

*On a solution of camphor in alcohol, as an extemporaneous microscopic object.*—This is one of the prepara-

tions which ought always to be at hand in the collections of those formed for the use of the microscope. It is true, that its configurations, formed by placing a drop of the solution upon a slip of glass under the microscope, very quickly disappear, owing to the volatility of the camphor ; but whilst they remain, they are exceedingly curious, and well deserving of examination.

*On minute strings of beads, produced by a species of mouldiness.*—Mr. T. Carpenter lately showed the Editor, as an opaque microscopic object, some white mouldiness, which had formed itself upon the skin of a herring, more than twenty years since.

Dr. Hooke, in his "*Micrographia*," also gives a figure of a species of white mouldiness, which had formed itself upon the red sheep-skin cover of a book ; and appeared, when examined by the microscope, "to be a sort of vegetable, pushing out multitudes of small, long, cylindrical, and transparent stalks, not exactly upright, but bending a little with the weight of a round white knob or ball, that grew on the top of each.

"Many of these knobs were very round, and had a smooth surface, others were of an oblong shape, and several of them were broken a little, appearing with a few clefts at the top, and others again were shattered, or flown to pieces.

"It was not easy to find out what these heads contained, whether they were flowers, or seed-vessels, but they seemed to bear the greatest resemblance to the heads of mushrooms, and were very disagreeable both to the taste and smell.

"Our author supposes (says the author of his "*Micrographia Restaurata*") that mushrooms, and the microscopic plants we are now describing, may be generated at any time, and from any kind of putrified substance, either animal or vegetable, without seed, merely by the friendly concurrence of either natural or artificial heat and mois-

ture; and adds, that he could never find any thing like seeds in mushrooms. But later discoveries have proved him greatly mistaken in this respect, by showing that mushrooms produce seeds in prodigious numbers, as any one may be satisfied, who will take the trouble to examine the gills of them with good glasses: and though it may be impossible to discern the like in these minute plants, it is not improbable that their round heads may contain also an abundance of seeds, which becoming ripe in a few hours, are spirted to some distance round about, where finding a proper bed, they presently spring up, and soon bear seeds themselves.

“And if so, we need no longer wonder at the speedy spreading of mouldiness over any body whereon it once appears. It must be owned, that heat and moisture, and oftentimes a degree of putrefaction in the substance, are requisite to make these minute plants thrive; but that such principles should be able to create them, must, I think, be past the belief of any who have studied nature by the help of glasses.”

We have for many years had, amongst our transparent objects for the microscope (placed between the talcs of an ivory slider) *minute strings of beads*, which were produced by this species of white mouldiness, and which had formed upon the surface of what had been a solution of sal polychrestum, but had dried up; and we have frequently met with them since, in the heads of the white mouldiness in question, and which is the same as that shown to us by Mr. T. Carpenter. We cannot but conclude, therefore, that these minute beads are, in reality, the seeds of the plants; and that their generation can no longer be said to be equivocal.

These minute plants are too frequently found surrounding animal and vegetable objects, when enclosed between talcs in the ivory sliders, after a few years remaining in that situation; and the minute strings of beads may be seen, with proper care, forming their heads. We have, however,

seldom seen them so large and perfect, as in the above-mentioned instance, of their forming upon the surface of the dried up solution of sal polychrestum.

(To be continued.)

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XIII.—*On Death-watches, Stomoxys Calcitrans, and other Insects.* By THOMAS CARPENTER, Esq.

DEAR SIR,

London, Jan. 10, 1829.

I MAKE no doubt but you have, in common with myself, met with many persons of weak minds, who are in a continual state of alarm, in consequence of prognosticating that evil is to befall them, from what they term, signs and tokens; amongst the most prevalent of these tokens, is the noise made by what they call the "Death-watch." The purport of this letter is, that in case any of your readers should be acquainted with persons possessed with this absurd opinion, they may be enabled to dissipate their fears, by explaining to them the natural causes of this singular noise, and which proceeds from two different insects: one, a coleopterous insect, of a dark colour, and about a quarter of an inch in length, the *anobium tessellatum*. Notwithstanding its smallness of size, however, this creature is often the cause of serious alarm, among the lower classes, from the noise that it makes; and which they consider as portentous of death to some one of the family in whose house it is heard. The philosopher and naturalist may smile at a superstition thus absurd; yet the celebrated Sir Thomas Brown has remarked, with great earnestness, that the man "who could eradicate this error from the minds of the people, might prevent the fearful passions of the heart, and many cold sweats, taking place in grandmothers and nurses." With the feelings of these persons a well known satirist sports in the following lines:

"A wood-worm

That lies in old wood, like a hare in her form;

With teeth, or with claws, it will bite or will scratch ;  
And chambermaids christen this worm a death-watch ;  
Because, like a watch, it always cries click ;  
Then wo be to those in the house who are sick ;  
For sure as a gun they will give up the ghost  
If the maggot cries click when it scratches the post.

*Swift's Invective against Wood.*

Another poet has also employed himself on the same subject :

" The weather's bell,  
Before the drooping flock, told forth her knell ;  
The solemn death-watch click'd the hour she dy'd."

*Gay's Pastoral Dirge.*

It is remarkable, that though the ignorant despise the minuter parts of the creation as too insignificant to engage their notice, and venture to deride those better informed, for their attention to what they deem such *trifling subjects*, yet they are the very persons on whom *real trifles* make the strongest impressions, and by whose credulity an apparently insignificant creature has been *magnified*, so as to become an object of considerable importance in the scale of beings ; for we may say of them as our great dramatist writer says of the *jealous*,

" Trifles light as air  
Are to the timid confirmations strong  
As proofs of holy writ."

It is chiefly in the advanced period of spring that these insects commence their noise ; and which is no more than the call or signal by which they are mutually attracted to each other, and may be considered as analogous to the call of birds. This noise does not arise from their voice, but from the insect beating on hard substances, with the shield or forepart of its head. The general number of successive distinct strokes is from seven to nine or eleven. These are given in pretty quick succession, and are repeated at uncertain intervals ; and in old houses, where the in-

sects are numerous, they may be heard, if the weather be warm, almost every hour in the day. The noise exactly resembles that made by beating moderately hard with the finger nail on a table. Mr. Stackhouse carefully observed the manner of its beating. He says, the insect raises itself upon its hinder legs, and with the body somewhat inclined, beats its head with great force and agility against the place on which it stands. This insect, which is the real death-watch of the vulgar, emphatically so called, must not, however, be confounded with another minuter insect, not much unlike a louse, that makes a ticking noise like a watch; but instead of beating at intervals, it continues its noise for a considerable length of time without intermission. This latter insect belongs to a very different tribe; and is the *termes pulsatorium* of Linnæus. It is usually found in old wood, decayed furniture, museums, and neglected books; and both the male and the female have the power of making this ticking noise, in order to attract each other.

The Rev. Mr. Derham seems to have been the first naturalist who examined and described this species. He had often heard the noise, and pursuing it, had found nothing but these insects; and which he supposed, from their minuteness, were incapable of producing it; but one day, by finding that the noise proceeded from a piece of paper, loosely folded, and lying in a good light in his study window, he viewed it with a good microscope, and observed, to his great astonishment, one of these insects in the very act of beating. They are more numerous in some years than in others; and their ticking is, of course, more frequently heard. Mr. Derham says, that during the month of July, in one particular summer, they scarcely ever ceased to beat, either in the day or night. The female lays her eggs in dry and dusty places, where they are likely to meet with the least disturbance; these are exceedingly small, and not unlike the nits or eggs of lice. They are generally

hatched about the beginning of March, a little sooner or later, according to the weather. After leaving the eggs, the insects are so small as scarcely to be discerned without the assistance of a glass. They remain in this larva state about two months, somewhat resembling in appearance the mites in cheese; after which, they undergo their change into the perfect insect. They feed on dead flies, and other insects; and often, from their numbers and voracity, very much deface cabinets of natural history.

They also live on various other substances, and may often be observed hunting for nutritious particles with great care and attention amongst the dust in which they are found, turning it over with their heads, and searching about somewhat in the manner of swine. Many of them live through the winter, but during that time, in order to avoid the inconveniencies of frost, they bury themselves deep in the dust. Accompanied with these remarks I send you a specimen of each insect for your examination.

About the middle of last summer I called on a friend who was labouring under a severe nervous affection, and found his complaint had increased very much in consequence of his hearing the noise from numerous insects of this smaller species. He did not, indeed, like to acknowledge the fact; but I clearly perceived that he had imbibed some of the superstitious ideas relating to them.

He informed me that the noise they made resembled the ticking of numerous watches, and appeared to proceed from the bottom of a wooden box which had contained figs, but which had all been consumed long since. I endeavoured to quiet his mind by informing him of what I considered to be the fact, viz.: that certain mites having found their way into the box for the purpose of feeding on the particles of dust from the figs, they had attracted another species of insect to the spot, which, most probably, not only partook of the sweets, but also fed on the first settlers also, and had themselves subsequently esta-

blished a colony in the box. That the ticking noise they made was nothing more than a natural one ; and instead of being the forerunner of death, was the signal which the insects made to each other in their courting season ; and therefore, that instead of being a summons to a funeral, it was of a very different nature.

During this time the insects were making an incessant ticking ; and, in order to satisfy my friend that my explanation was correct, I shook out the contents of the box into a shallow glazed dish ; I then pointed out numerous insects to him, from which I assured him the noise we had heard had proceeded. Some of these insects I placed between concave glasses, and, in due time, found the eggs and young produced in the manner described by Mr. Derham, as before stated. While in the larva state, they eat the greater part of the bodies of their parents ; after which, they soon died. Some of these I have placed within a talc slider, which I also send you.

As I knew, to my cost, that these insects in the perfect state were excellent anatomists, having had many fine specimens of insects in my cabinet destroyed by their operations, a thought occurred to me that I might possibly render them useful in making some delicate dissections for my microscope ; and, in order to try the experiment, I placed a few of the insects within a pill-box, into which I also put the heads of three dead flies. On looking into the box some time afterwards, in order to see how they had proceeded in their anatomical operations, I found they had cleared the interior of some of the eyes completely from all the blood vessels, leaving the lenses in the cornea most beautifully transparent, and so totally unlike any preparations of my own, that I placed portions of those cleared eyes between slips of glass as a natural curiosity ; and also to show how useful those little creatures might be made in producing exceedingly fine dissections. I have sent the sliders herewith for your examination.

A singular circumstance occurred to me with one of these insects, which shows what a tenacity of life they possess. In order to kill it, I put it into hot water, as usual; and having taken it out, apparently dead, I placed it on a piece of card, attached by a little gum-water. On examining it four hours afterwards, I found it was alive, and struggling to free itself from the gum. I was at a loss to imagine how it had preserved its life in the hot water, but, on looking into the water, I found a cast skin, which, I presume, the insect was preparing to throw off at the time I put it into the water; and which skin being loose and partly detached from its body, had protected and preserved the vital parts from being destroyed. The insect and its cast skin I also send you for your inspection. You will observe how very prominent and numerous the eyes (which are compound ones) are in this minute insect.

On paying another visit to the friend before mentioned in the autumn of last year, I found him out of temper with certain flies, which he said had annoyed him very much by stinging and biting his legs, and which caused such extreme pain and inflammation, that he could only describe the smart he endured as if some little imps of mischief were tormenting him by piercing his legs with exceedingly sharp needles! Some of these flies he had caught and killed; and he said that he was determined to kill every fly he met with in the house as useless pests. I requested him to reflect a little before he commenced hostilities against an unoffending and harmless species of insects; and which, no doubt, had some important duty to perform in the scale of creation, although we were too short-sighted to see the benefits derived from them. And I particularly requested him not to kill those lively little friendly companions of the tea-table, whose greatest crime appeared to be that of partaking in a small portion of our milk and sugar. I informed him that the flies which had so tormented him were of a very different genus from those latter

ones, which were the *musca domestica*, and which never inflicted any wound. But that the tormentors which he had so much reason to complain of were the *stomoxys calcitrans*; the wounds made by which insects, I agreed with him, were not to be borne with patience, and he had therefore my full consent to kill them whenever he was attacked by them.

Those he had killed I took home with me, and having dissected the heads of two or three, I found the proboscis or rostrum to be a sucker, with a single valved sheath, enclosing two instruments for piercing the skin and sucking the blood. Their eyes are compound ones; and each, like those of the common house-fly, consists of many thousand distinct eyes. The above dissection, with two or three of the perfect insects, I now send for your examination. You will perceive them to be of quite a different genus from the common house-fly; and they are only to be found in the house during the autumn. Both myself and horse have repeatedly suffered much from their attacks within and without doors during that season, and I consider the pain which they inflict to be much worse than that caused by the bite of the *tabanus*, as mentioned by me in a former letter; and when you have examined a set of its instruments, I think you will agree with me in this opinion.

Lambert, speaking of them, says, "I have sat down to write, and have been obliged to throw away my pen in consequence of their irritating bite, which has obliged me every moment to raise my hands to my eyes, nose, mouth, and ears, in constant succession.

"When I could no longer write, I began to read, and was always obliged to keep one hand constantly on the move. Sometimes, in the course of a few minutes, I would take half a dozen of my tormentors from my lips, between which I caught them just as they perched."

All that Lambert states is very true, I speak experimentally; and I would sooner sustain the attack of a

*tabanus* on my face with all its instruments (six in number) for a minute, than I would the insertion of one of the instruments of the *stomoxys* for one moment! My horse seems to have had the same kind of feeling, for I have known him plunge and break his halter in the stable; and when annoyed by them on the road he has become quite unmanageable.

I am, dear Sir,

Yours very sincerely,

To T. GILL, Esq.

THOS. CARPENTER.

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XIV.—*On the Art of the Liquorist.*

(Concluded from page 60.)

THE perfection of the liquorist's art consists in his thoroughly studying the nature of the perfumes which he employs, and in making his mixtures thereof according to the proportions which are best fitted to develop the principal flavour which should predominate in the *liqueur*, but avoiding all acidity; and also, in employing with prudence and good management those other substances, which, without being distinguished by their peculiar tastes, are nevertheless necessary to strengthen that particular perfume which we have a view in employing. The *liquorist* ought therefore to possess a most delicate taste; he ought also to know at least as much of chemistry as should prevent him from hazarding the mixing of those substances together, which, by decomposing each other, would afford results the most contrary to those he is endeavouring to obtain. He ought likewise to thoroughly understand the principles and the practice of distillation, as well as to be able to prepare his spirits, and the plants, flowers, roots, woods, &c., and to extract their perfumes, and which he must employ every instant in his business.

The art of the *liquorist* is one of the most important

applications of chemistry ; and one, which those who are but little versed in this science, can have but small hopes of carrying to that degree of perfection of which it is susceptible. Before chemistry had made such progress, the *liquorist's* art was an empiric one, and every thing was done at hazard. Formerly, whenever any one fortunately happened to compose a *liqueur*, which pleased both the taste and smell, he was praised up to the skies ; and every one endeavoured either to obtain his recipe or to imitate the *liqueur*. Now, since we have studied the true methods of operating, we work with greater ease, and more economy ; and obtain results which are more pleasing to the taste, as well as much more wholesome.

We shall now give the recipes for several new *liqueurs*, which have never before appeared in print ; and are, indeed, the results of our own experiments. We are convinced, that by following the processes, excellent *liqueurs* may be made by infusion ; and to which the properties, either of an oil or a cream, may be given with facility.

No. 1. *Baume des Moluques*.—We infuse for ten days, in a stone or glass vessel, capable of holding twenty kilogrammes of water, five kilogrammes of brandy, at eighteen degrees, two kilogrammes of white sugar, two kilogrammes of river water, fifteen grammes (four gros) of cinnamon, in powder, fifteen grammes (four gros) of cloves, powdered, and three grammes (forty eight grains) of mace, bruised. The whole must be shaken or stirred up three times a day ; and a brown colour is to be given to it by caramel (burned sugar). At the end of the ten days it must be filtered, and put into closed bottles.

No. 2. *Larmes des veuves du Malabar*.—The same quantities of brandy, sugar, and water, as in No. 1 ; to which we add fifteen grammes (four gros) of powdered cinnamon, three grammes (forty-eight grains) of bruised cloves, and the same quantity of mace. This must be slightly coloured with caramel.

No. 3. *Les délices du Mandarin*.—Brandy, sugar, and

river water, in the same proportion as in No. 1; and either add fifteen grammes (four gros) of starry aniseed (*badiani*) or of *ambrette* (*hibiscus abelmoschus*, L.) in powder; and also seven or eight grammes (two gros) of *carthamus*, or bastard saffron.

N.B. We must take care in giving a gold colour to this *liqueur* with the bastard saffron, as its smell resembles that of honey, which smell it may also communicate to the *liqueur*, and render it disagreeable.

No. 4. *Les soupirs de l'amour*.—Brandy, sugar, and rain water, in similar proportions with No. 1. But we perfume it with the essence of roses, of which we add a sufficient quantity to give it the required scent. A pale rose colour is given to it by the tincture of cochineal, as we shall describe below. It must be filtered when the sugar is dissolved; after which it must be well stirred up five or six times, and then be put into well stopped bottles.

We can also make this *liqueur* without employing the essence of roses, as follows:—Five kilogrammes of brandy, at eighteen degrees; two kilogrammes of white sugar; of rose-water, distilled in the manner hereafter described, a sufficient quantity to give it a fine perfume. If the *liqueur* should prove too weak, more brandy must be added to it of thirty-six degrees; but if it be too strong, dilute it with rain-water; and if it has not a sufficient consistence, add syrup to it.

The rose-water which we recommend, is made in the following manner:—We place in the body of a still, a layer of rose-leaves, then another of powdered kitchen salt; then another layer of rose-leaves, and another of salt upon that; and so on, up to the neck of the still, observing that the last layer is a slight one of salt. We then fill the body with water; and proceed to distillation. The first distilled products are to be re-passed a second and a third time upon new rose-leaves, arranged as in the first distillation, with salt between the layers. After three distillations the rose-water will be perfect.

No. 5. *Crème de macarons*.—Brandy, sugar, and rain-water as in No. 1; to which we add 245 grammes (demi-livre) of bitter almonds, peeled and well bruised; cloves, cinnamon, and mace, also bruised, of each three grammes (forty-eight grains). Or we may substitute for the bitter almonds, the kernels of peaches or apricots, should they be thought too acrid.

This *liqueur* is made of a purplish or violet colour, with a decoction of litmus, to which is added prepared cochineal, to give it a fine tint.

No. 6. *Curacdo*.—We put into a large bottle, nearly filled with alcohol, at thirty-four degrees of Baume (or thirty-six) the peels of six fine Portugal oranges, which are smooth skinned, and let them infuse for fifteen days. At the end of this time we put into a large stone or glass vessel, five kilogrammes of brandy at eighteen degrees, two kilogrammes of white sugar, and two kilogrammes of river-water. When the sugar is dissolved, we add a sufficient quantity of the above infusion of orange peels to give it a predominant flavour; and we aromatise it with three grammes of fine cinnamon, and as much mace, both well bruised. Lastly, we throw into the *liqueur*, thirty-one grammes (one ounce) of Brazil wood, in powder. The whole is left in infusion ten days, being stirred three or four times a day. At the end of this time we taste the *liqueur*; if it be too strong and sweet, we add more water to it; if too weak, we add alcohol, at 36°; and if it be not sweet enough, we put syrup to it. We also give it colour with caramel when we would tinge it.

No. 7. *Etrait d'absinthe de Suisse*.—Many persons having inquired for the composition of this *liqueur*, we trust that we shall give them a gratification in communicating a recipe given us by the late Cadet Gassicourt, who brought it from Switzerland.

“The distillers of Geneva, Basle, Zurich, Neuchâtel, Berne, and Lausanne, make a great trade in an alcoholic *liqueur*, aromatized by wormwood and aniseed, and

marking about twenty-four degrees of Baume's areometer. This *liqueur*, which is called *extract of wormwood*, is composed in the following manner:

Summits of the greater wormwood	2 kilogrammes.
— of the lesser ditto - - -	1
Angelica roots	} of each - 0,122 grammes.
<i>Calamus aromaticus</i>	
Seeds of the starry aniseed ( <i>badiane</i> )	0,061
Leaves of the dittany of Crete - -	0,031
Alcohol, at 20 degrees - - - -	18 kilogrammes.

“ These substances are infused for eight days : they are then distilled over a gentle fire, and we draw off nine kilogrammes of spirit, to which we add eight grammes (two gros) of the essential oil of green aniseed. The nine kilogrammes which remain in the alembic, serve for the preparation of a vulnerary spirit.”

Most of the manufacturers colour their extract of wormwood either with the expressed juices of smallage or of spinach. This colour is very fine at first, but the light destroys it. Nevertheless, as a green colour is pleasing amongst the *liqueurs* at table, such as those of wormwood, mint, emerald-water, &c., so we will indicate a process by which we can obtain all the tints of green, and which are likewise durable.

*On colouring liqueurs.*—We ordinarily colour *liqueurs* yellow, fawn-colour, red, violet, or green. The object is to employ permanent colours which shall not be prejudicial to health.

*Yellow.*—The *safranum* or *carthamus tinctorius* contains two colouring parts, yellow and red : the first, the yellow, is soluble in water only, and is that with which we are at present occupied. In order to tinge *liqueurs* yellow, we infuse the petals of this flower in them, in a greater or less quantity, as we would have the yellow lighter or deeper.

*Fawn colour.*—The caramel gives a fawn colour more or less deep. To prepare it, we take an iron ladle, which is very clean, and put into it powdered white sugar, and place

it over a stove; the sugar melts, and must be constantly stirred until it takes a perfectly equal brown colour; but we must take great care that it is not burnt. When it has attained the desired colour, we must throw water into it, and stir it up well; it will dissolve entirely, and yield a colour more or less deep, as more or less of it is employed.

*Red.*—Cochineal affords all the shades of red, accordingly as it is used in greater or less quantities; but the process for preparing it is always the same. We bruise the cochineal in a mortar, adding to it a sixth part of alum in powder: when these two substances are well pulverized, we pour boiling water upon them, and mix them well together with the pestle; we throw this colour into the *liqueur* after previously passing it through a filtre.

*Violet.*—Litmus yields a violet colour; we reduce the lumps of this material to a subtle powder in a mortar, and pour boiling water upon it: we add this mixture to the *liqueur* until it is coloured to the requisite degree, and finally filtre it.

*Blue and Green.*—Indigo dissolved in the sulphuric acid affords a permanent blue colour. We take indigo in powder, and grind it up with a small quantity of water in a glass mortar, with a pestle of the same material; on this we pour, from time to time, a little concentrated sulphuric acid, at 66°, or until the indigo appears to be entirely dissolved. We then add to the solution carbonate of lime in powder, which neutralizes the sulphuric acid, forming with it sulphate of lime, which precipitates. We then treat the mixture with alcohol, which becomes charged with the blue colouring matter of the indigo. After filtering it and mixing it with the yellow of carthamus, we obtain all the varieties of green which we can possibly desire. This preparation is not injurious to the health, nor does it change the flavours of the *liqueurs* which are coloured by it. The confectioners use it also to tinge their green sweets with.

The liquorist also makes the artificial wines or ratafias,

in which he employs all kinds of fruit, such as oranges, peaches, apricots, cherries, raspberries, strawberries, mulberries, &c. He takes these fruits, when they are perfectly ripe, and expresses their juices, which he suffers to rest for twenty-four hours, and then passes it through a linen cloth. In each *litre* of juice he dissolves 245 grammes (eight ounces) of white sugar, and then adds alcohol of 36° until it has sufficient strength. He leaves the whole to macerate during fifteen days; filters it, and puts it up into bottles. These wines or ratifias were greatly used formerly.

Many liquorists also prepare the waters for the use of the toilette; but these more properly belong to the art of the perfumer.

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XV.—*On the Mordants used in Dyeing, Calico Printing, &c.\**

THIS term is used in many of the arts to designate the agglutinating substances; which cause, by their application to different surfaces, the adherence of certain bodies to them. This is the term which is given in the art of carving and gilding, to the kind of varnish or size which serves to cause the leaves of gold or silver to adhere to their works. In other arts, on the contrary, they call *mordants* the acid agents, by the aid of which they attack or corrode the surfaces of metals, in order to clean them. But in dyeing and calico printing, they attribute to the same word another meaning. It is chiefly used to describe those bodies which enjoy the double property of intimately combining with the organic fibres of the materials to be dyed or printed, and the colouring matters, from whence there results a triple combination, the mordant serving as the common bond of union between the colouring materials

\* From the *Dictionnaire Technologique*, 1828.

employed, and the tissue; so that their union is more intimate, and the dyes are, consequently, less perishable.

Such is the use of the mordants which form one of the principal bases of the arts of dyeing and calico printing. We shall now enter into farther particulars, by which we shall render their importance better understood.

In order to perfectly appreciate the utility of mordants, and their true functions, we must premise, that the colouring materials generally contain principles *sui generis*, and which possess particular affinities. Their distinctive characters in general are, that they are neither acid nor alkaline; and yet, nevertheless, have the power of combining with certain bodies, and more particularly with their bases, and receive from each modifications in their colour, their solubility, and their changeability. The pure organic colouring materials possess a very energetic affinity for certain bodies, a weak one for others, and nearly none at all for some. Amongst these primitive materials, some are soluble in pure water, whilst others can only be employed through the agency of particular substances. We may then conceive, after what has been stated, that amongst them all, a colouring substance may enjoy a certain affinity for the organic fibres, so as to be fixed or dyed with the mediation of mordants; and also, that it may be insoluble in water; and, in fact, this is the case with the colouring matter of carthamus, annatto, and indigo. The two first are soluble in alkalies. It is sufficient, therefore, in applying them to dye cloth, to make a solution of them in an alkali water, to plunge the cloth to be dyed into it; and to precipitate the dyeing material, by saturating the alkali in the solution by means of an acid. The colouring matter, at the moment when it is separated from its solvent, is in a state of great division; and is brought into contact with the organic fibres, with which it has a certain affinity. It is thus intimately united with them; and, as it is naturally insoluble in water, or, as we may say, has no affinity for this vehicle, so any subsequent washings will not dis-

charge the dye. It is not exactly the same with indigo, as its solubility in the dyeing bath does not depend upon a similar cause, but upon a change in its constituent principles. It is, however, certain, that after having been subjected to this modification, it becomes soluble in the alkalis; and when the cloths are plunged into a bath, impregnated with this solution, and are exposed to the air, the dyeing matter at once resumes its colour; and its original insolubility; and which subsequent washings cannot deprive of more than the superabundant portions remaining after the combination is effected; and which portions were merely deposited upon the cloth.

Thus we see, that it may happen, that the insoluble colouring matters, which exist together with those which possess more or less solubility, may not possess such an affinity for the organic fibres, as that the combination formed between them should be firm; but that water has an affinity for the colouring matter which balances and frequently exceeds that which it has for the cloth.

In this case the dyers are obliged to have recourse to intermediate bodies, which may add their proper affinity for the colouring matters to that which they possess for the organic molecules of the cloth; and thus augment by this double action the intimacy and the stability of the combination. These are the intermediate bodies which have received, as we have before-mentioned, the name of *mordants*.

The mordants are in general taken from amongst the bases and the metallic oxides, and it would appear at the first glance that there exists a great number of them; but when we see that they must combine the double condition of possessing a strong affinity both for the colouring matters, and for the organic fibres; and if, above all, we reflect that the insoluble bases are few which possess the power of forming insoluble combinations, we shall perceive that their number is singularly limited. We know, in fact, that lime and magnesia, for example, possess a great affinity for

colouring matters, and are capable of forming insoluble combinations with them ; and they are generally employed as mordants, because they likewise possess an affinity for the organic fibres of the cloth.

Experience has shown, that of all the bases, those which succeed best as mordants, are alumine, tin, and the oxides of iron ; and also, that as the two first are naturally white, so they are the only ones which are fit to be employed when we would preserve the dyeing material of its original colour. On the contrary, if the mordant were coloured ; we may conceive that there will necessarily be produced a colour entirely different from the primitive one.

If, as we have above said, the mordant forms a true combination with the cloth to be dyed, it results that the application of it should also be made under those circumstances which are the most capable of favouring the combination ; and this, in fact, is daily practised in the dye-houses. We shall now enter into some details in this respect.

In order that a combination may be properly effected, it is in general necessary, not only that the bodies which are to be brought into contact should be in a state of liberty, or, at least, as nearly in that state as possible ; but it is also known that the combination is best effected when the molecules are in the greatest state of division. As the mordants which act so as to combine with the tissue are, as we have before said, insoluble by themselves, so we are obliged, in order to divide their molecules, to dissolve them in an appropriate vehicle : but this solvent also necessarily possesses, on its own account, an affinity for the mordant, which becomes an obstacle to its union with the tissue. And thus we must choose amongst the solvents that whose attraction for the mordant is the weakest : and, as of all the acids which we can employ to dissolve alumine, for instance, vinegar is that which is retained with the least energy, we therefore generally substitute the acetate of alumine in place of alum, because the acetic acid abandons

the alumine with such facility that a mere elevation of temperature is sufficient to effect the separation of these two bodies. Before the substitution of the acetate we used alum only ; but the true reason was never known why the dyers always gave the preference to Roman alum, and regarded it as being the most pure ; and it is only within these few years that it has been known to what this preference was owing, as it had for a long time been improperly attributed to prejudice. M. D'Arcet was the first to perceive that this alum was not of a similar composition with other kinds, and that the greater part of it was cubic alum ; that is to say, that it contained an excess of base when compared with the ordinary alums. But the sulphuric acid can take up an excess of the base, and more than is sufficient for its saturization, but which it readily parts with ; and when we heat a solution of cubic alum we find that this superabundance of alumine separates, some in the state of a sub-sulphate, and some in the form of pure alumine, long before it has attained the boiling point. Nevertheless, we could not detect this difference, because the Roman alum, in its ordinary state, is soiled by a peroxide of iron, which clouds and obscures the solution, so that we cannot, in consequence thereof, perceive this precipitate of alumine and the sub-sulphate ; and when we filtre the liquid in order to crystallize it anew, we merely obtain the ordinary octahedral alum ; we must therefore conclude, in short, that the preference in favour of Roman alum has no real foundation ; and that there exists no other difference between it and other alums than what may result from their being more or less pure.

We will here mention an anecdote which it may not be useless to quote in this place, in order to show how great the prejudice is against making any change in the processes employed in the arts. During the time when France was master of Rome, one of our most skilful chemists was sent there to inspect their different manufactures, and to compare them with ours. One of the chief manufactures was

this of alum ; but he found that the construction of their furnaces was so bad, that their vast cauldrons could only be heated at the bottom, and could not be made to boil. He strongly advised them to build them upon another and better plan, but in vain ; as they were determined to follow the wise doctrine of adhering to the old established practice ! Had the manufacturers followed the advice he gave them, they might have always produced the octahedral alum ; as, according to the experiments made by M. D'Arcet, he always found that the cubic alum became decomposed at a temperature of from 40 to 45 degrees.

At one time the Roman alum was exceedingly scarce in France, and it therefore occasioned us to take considerable pains to purify that of our own manufacture, because we clearly perceived, as we have above stated, that its particular state was the only cause to which we could attribute the different effects obtained from it ; but, as we also wished to procure an alum which should be perfectly free from any admixture of iron, which is by no means the case with the Roman alum, so we were led, according to the advice of M. D'Arcet, to add to the bath, at the moment of aluming, a little alkali. In fact, we thus produce the cubic alum by diminishing the proportion of the acid in thus saturating a part of it.

The two principal conditions of a great division of the molecules and their state of liberty are fulfilled by this mordant, and its operation is easily effected ; but it is to be observed, that the combination which it forms results from a play of affinities between the solvent and the material of the cloth, which produces a species of division proportioned to the mass of the solvent. Thus, the cloth retains more of the mordant when the solution is most concentrated ; that is to say, when the insoluble base is least defended by the greater mass of the vehicle ; and we found an important part of the process of dyeing upon this observation. If we impregnate, for example, different parts of the same piece of cloth with the same mordant, but at

various degrees of concentration, we obtain, on plunging it into the dye-bath, a fixation of the colouring matter the more intense as the mordant was the more concentrated. And thus, accordingly as the acetate of alumine is more or less concentrated in maddering, we produce all the shades from the deepest red to the lightest rose-colour; and with the acetate of iron and madder all the tints from black to a light violet.

We see, after what has been above stated, that it is indispensably necessary to employ mordants at different degrees of concentration; and it is easy to obtain this result by varying the proportion of the vehicle. Thus, to procure the acetate of alumine more or less concentrated, it is sufficient to add more or less water to the required quantities of acetate of lead and alum. If we would directly prepare the acetate of alumine by saturating the acetic acid with this base, the degree of density of the solution indicates its degree of concentration, and the areometer will serve as our guide in this respect; but as this mordant is more frequently formed by the reciprocal decomposition of acetate of lead and alum, and as this last salt contains, besides the alumine, potash; so there is also formed an acetate of potash which remains in the liquid and increases its density.

In the manufactories of the pyroligneous acid, where the acetate of lime is prepared in the large way for procuring the acetate of soda, and eventually the acetic acid, they have endeavoured to directly apply the acetate of lime, which is but little expensive, to the preparation of the acetate of alumine; and always by the double decomposition of the alum. Nothing is more easy, in fact, as the sulphate of lime thence resulting possesses so great a degree of insolubility as to permit this double decomposition; but as, nevertheless, there remains another portion in solution, and as we are obliged to employ an excess of alum, so there always remains in the liquid a large quantity of lime which produces an ill effect on the tints, which the acetate of

alumine is intended to produce; and for this reason it is rejected by the manufacturers of printed calicoes.

From the time when it was known that the acetate of alumine was preferable as a mordant to alum, it was admitted, as a necessary consequence of this discovery, that the best proportions for obtaining the acetate were precisely those in which the two salts were most completely decomposed. And chemical analysis has shown that 100 parts of alum contain 10.5, or nearly, of alumine; but 10.5 of alumine require for their saturation 31.5 of acid: and it will take no less than 116 parts of acetate of lead to furnish this quantity of acetic acid.

We know that the common alum is composed of sulphuric acid, alumine, potash, and water; and we may also consider it as being composed of sulphate of alumine, sulphate of potash, and water. We also know from experiment, that portion of the acetate of lead necessary, namely those first added, unite themselves by preference with the sulphate of alumine; and the only aim of this process being to obtain the acetate of alumine, it results that it is useless to employ more of the acetate of lead than is sufficient to decompose the sulphate of alumine; as all which we add above that proportion is entirely lost.

Agreeably to the data we have given, we admit that the most convenient proportions to obtain a completely reciprocal decomposition are 100 parts of alum to 116 of the acetate of lead; supposing that these two salts are in a state of purity, and do not contain more than their proper proportion of water.

As to the mode of preparing this mordant, that possesses no difficulty; only, that as the alum is but little soluble in cold water, so it is convenient to make the solution by heat, and in four parts or more of water. After the solution is effected, we add a little sub-carbonate of soda to saturate the excess of acid before we add the acetate of lead; this may be about a tenth part of the weight of the alum: and we then add the proportion of acetate of lead, well powdered

and sifted ; we then briskly stir the mixture, and renew the stirring from time to time, until it is become quite cold. We then allow it to remain at rest to deposit, and draw it off by the help of a syphon ; lastly, we throw the sediment upon a filtering cloth, and strain it hard, in order to obtain the last portions of the liquid.

The mordant thus composed, is one of the strongest which can be employed, and it is seldom necessary to concentrate it ; but rather to employ water to dilute it to the requisite degree ; and we also know that when thus diluted it keeps the better.

Most manufacturers instead of pursuing the course we have indicated, prefer to employ less acetate of lead in procuring the weaker mordants, and think that they find an economy in doing so. Now we think that there is a loss in this respect ; for, although we well know that alum is a good mordant, yet, when we also know that the acetate of alumine is preferable to it, so we find it an advantage to obtain it as pure as possible ; and the good quality of the mordant is always proportionable to its richness in the acetate of alumine.

After having thus established, in a general way, the necessary principles for obtaining a good mordant of the acetate of alumine, and which is that which is most frequently employed, we shall next proceed to describe some theoretic rules which must be followed in order to effect its combination with the organic fibres of the cloth which is to be dyed. Premising that the first condition to be observed is precisely that which takes place in any other combination, that is to say, that the bodies which are to be united be freed as much as possible from all foreign substances, whose presence would necessarily hinder that immediate contact, without which, their union could never be effected ; and it is this motive which obliges us to wash and scour the stuffs previous to mordanting them, as we are obliged to clean the surfaces of metals before we wish to combine them, by applying them to each other. This

being premised, we must remark, that it is not necessary to uniformly mordant the two surfaces of the cloth, nor is it indeed easy to do it, as it would require them to be completely immersed in the mordant; but it is but rarely this is required: generally, on the contrary, if we would mordant designs which are more or less delicate, and whose outlines are neatly drawn; it would be impossible to obtain this result with the mordant which we have described, or to use it for plate or cylinder printing; or, indeed, in any other mechanical mode. The too great fluidity of the liquid would not permit it to enter the lines of the engraving in sufficient quantity to deposit an adequate portion upon the cloth; but this fluidity would also cause it to spread too much, and thus all the lines of the design would become coarse. In order to obviate this double inconvenience, they have hit upon the following contrivance: in order to give a convenient consistence to the mordant, they add to it a certain proportion of a viscid body which is not likely to change the tint of the colouring materials, or to exert an improper re-action upon the mordant. The gums, the feculas, either pure or roasted, and also tobacco-pipe clay, are employed with success for this purpose, but not indifferently; and practice has suggested the proper choice to be made of them. We see, for instance, that acids act very powerfully upon the feculas; and we must, therefore, if possible, avoid bringing them into contact with each other. And thus, when the mordant contains a notable excess of acid, it is best to thicken it with a gum. There is also another motive which determines them to give a preference to a gum, and that is the difficulty they experience, after the action of the mordant has taken place, to free the cloth entirely of the fecula; any small remaining portions of which would injure the brightness and transparency of the colours.

But the advantage which a viscid body procures, that of affording an impression more precise and neat, is subject to the inconvenience of impeding the immediate contact of

the two bodies which we wish to combine. And therefore, in order to lessen this defect as much as possible, we must only employ that quantity of it which is absolutely necessary; and it is this motive, which merits great consideration, that determines us to give the preference to a body, which, in an equal weight, affords the greatest consistence. This is the reason that they have recourse, in some cases, to pure fecula, to gum tragacanth, and to salep.

These auxiliary substances, however, produce another inconvenience, against which it is necessary to guard; this is, that they experience, under certain circumstances, a too quick desiccation; and lock up, in a manner, the mordant, before it has experienced the modification to which it should be subjected; and which principally consists in the evaporation of its acid, when exposed to a free air.

It is not sufficient, therefore, that the mordant should be conveniently applicable; but also, that it should be placed in the most favourable circumstances for its decomposition, and the combination of its base with the cloth to be mordanted; and this can only be effected in a truly efficacious manner, by keeping the mordanted cloth, for a certain time, in a place where the temperature is moderately elevated, and the air has free access. It is also necessary that the cloth be regularly extended; and that the air which circulates over its surface be neither too dry nor too moist. It is only by taking these precautions that we can obtain that uniform but progressive setting free of the acid in the mordant, from which arises the intimate combination of the alumine with the cloth. It is therefore necessary for the person who directs the establishment, to be able to appreciate all the influencing circumstances, in order that he may be able to govern them, and to supply what is defective. Thus, in a cold and wet season, he should elevate the temperature of the drying loft, in order to obtain an evaporation more decided; on the contrary, when the atmosphere is too hot and dry, he should either intro-

duce humidity, or add to the mordant a deliquescent material, in order to prevent those signal inconveniences which are caused by a too quick desiccation.

Now even supposing that the application of the mordant, and its combination with the cloth, has been well directed, it does not therefore follow that much of the process has been entirely finished ; but we may say with truth, that there yet remains to be performed the most important and the most difficult part of it. In fact, we again repeat, that the mordant is not solely destined to combine with the organic fibres of the cloth, but that it must also combine with the colouring substances ; and that, consequently, it must be entirely exposed, and completely freed, from all foreign matters, which might clog and hinder its contact with the colouring matter. This is the principle and the aim of the two succeeding operations, to which they have given the name of *dunging* and *clearing*.

If the mordant which was applied upon the surface of the cloth had been entirely decomposed, and the whole of its base intimately combined with it, it is certain that a simple washing in water would have been sufficient to raise the viscid substances which were added to it, and to remove them. But it is not so ; as, whatever precaution we take, a part of the mordant remains untouched ; and, which is more, a part of the base of the decomposed portion has not entered into a combination with the cloth, but remains free, and in surplus. We must therefore contrive the means of removing all these bodies, otherwise there will result another mischief. And as it is evident that in this state, if we were to be contented with merely immersing the cloth in water, that portion of the mordant which remains free, would dissolve and combine indiscriminately with those parts of the cloth which were not mordanted, and finally defend them from the action of the colouring matters ; but if we add to the washing water a body, capable of seizing the mordant when mixed with it, and of forming an insoluble combination with it, it will

then remove it in a certain degree, and prevent it from producing any effect upon the cloth. Such, in fact, is the result we obtain by the addition of cow-dung. This excrementary substance contains a large proportion of soluble animal matters, and of colouring particles, which possess a great affinity for the aluminous salts. The heat which is given to the dung-bath accelerates this combination, and forms an insoluble and perfectly inert coagulum.

Thus the dung-bath produces a perfect solution of these bodies; a most intimate union is formed between the alumine and the cloth, by means of the elevation of the temperature, which necessarily favours this combination; and an effectual removal of the undecomposed part of the mordant, and also, in a degree, a mechanical separation of the particles of alumine which were not entangled in the fibres of the cloth takes place; the entire separation being only completed in the operation of *clearing*, which is done in a large quantity of water, by the aid of the dash-wheel, which produces a movement that greatly facilitates the expulsion of the foreign particles.

We have confined ourselves to giving the theoretic considerations only, which should guide us in the important operation we have been describing; but it may easily be conceived, that many practical observations remain also to be made; which, however, cannot find a place in this article; and indeed are only to be learned in the workshops, and not in books.

Before terminating this article, we shall say a few words respecting astringents, and particularly upon gall-nuts, which are arranged amongst the mordants. But it is very difficult to render a good account of the real office they perform. We intend to speak more particularly of them, when we describe the processes for dyeing black, because in this case they also act as dyeing materials, and not merely as mordants, as the black results from their combination with the oxide of iron. But we here speak of those circumstances in which we employ astringents as mordants

simply, as in the proocess for dyeing the Indian red. All that is known in this respect is, that the astringent matter, or *tannin*, of which the nature is unknown, combines as a mordant, both with the cloth, and the colouring substances, and thus fixes them; but as the colour of the tannin is a brown, more or less deep, so it follows, that it cannot be employed for light colours.

R.

#### XVI.—*On the Preparation of Gold Sizes and Varnishes\**.

PAPER, vellum, silk, &c. are readily gilt by various sizes, for which there are many recipes; as the following for instance:—

1. Ale, in which honey has been boiled, mixed with a little gum-arabic.
2. Gum-arabic mixed with sugar.
3. The juice of garlic, or that of an onion, or a hyacinth root, to which a little gum-arabic has been added; these retain the leaves of gold or silver firmly, but we must not use too much gum, lest the gold or silver parts should crack or scale off.

As these liquids are as colourless as pure water, so it is well to mix a slight tint of carmine with them in use, in order to know the places on which we have laid the size. And when we apply upon these parts the gold and silver leaves, which we intend to use, we must take up rather larger pieces than the boundaries of the design, and fix them, by applying upon them a tuft of cotton or cows' hair; and when we think that the size is become dry, we rub them over with the cotton, in order to remove those parts of the leaves which are not fixed by the size, and thus render the outlines of the design more exact.

There are certain works which we desire to gild in varnish, but we must know the precise moment when the

\* From the *Dictionnaire Technologique*.

size becomes of a proper degree of dryness, or otherwise we shall be embarrassed in seizing the favourable moment ; for if it be too dry, the gold will not adhere to it ; and if it be not dry enough, the leaves of metal will become dull, and scarcely visible. The varnish which the Dutch used to supply us with has not these inconveniences. A quarter of an hour was sufficient to dry it to a proper degree. The process for preparing it is no longer a secret—it is as follows:—

Into a glazed earthen pot we put a pound of linseed-oil, and six ounces of litharge ; also Venice-turpentine, black resin, and powdered umber, an ounce of each ; likewise an onion and a crust of bread ; and then boil the whole for three or four hours. We know that the composition is sufficiently boiled, when, on taking up a little in a ladle, and letting it cool, it draws out into threads. We then remove the pot from the fire, and when the composition is nearly cold, we take out the onion and the crust of bread, and add to it four ounces of the essential oil of turpentine ; we then strain it through a cloth, and preserve it in bottles close stopped for use.

This varnish or size, although very good, is nevertheless not the best. We substitute in place of it another ; the process for making which we have procured from England, where it is employed for gilding in dead gold, as also in bronzing. The following is the recipe :—

We melt one pound of asphaltum, and pour into it another pound of linseed-oil, rendered drying by litharge ; and also add to it half a pound of red lead or vermilion. When the varnish becomes thick or pasty, we thin it by adding a pound, or a pound and a half, of spirit of turpentine ; as more is required in winter than in summer.

We employ as a gold-size, the deposit which forms in the bottoms of vessels, in which the pencils or brushes employed in laying on colours ground and mixed with oil, are washed with spirit of turpentine. This matter is exceedingly thick and viscid ; it is again ground, and when

strained through a cloth, serves as the basis of the size ; and the older it is, the more unctuous it becomes.

During these thirty years, the most skilful workmen have however discontinued the use of this latter size for gilding in oil with ; and employ in its stead, a composition to which they have given the name of *mixture*, to distinguish it from the latter size, of which we have given the recipe. It is a liquid which is found to be the best size for gilding in oil with, as it is thinner, and is not perceived under the gold leaves. The following is the recipe for preparing it :

We melt together one pound of amber, four ounces of gum-mastich, in tears, and one ounce of asphaltum ; and add to it one pound of linseed-oil, rendered drying by litharge.

This size must not be used in too liquid a state ; nor should it be too long nor too speedy in drying ; it should be capable, however, of spreading easily under the pencil.

The manufacturers of paper-hangings use a size of this kind in applying gold or silver leaf upon their works ; and also to fix upon the paper the powder of cut woollen cloth, or flock, in order to imitate velvet. The size we have last described the composition of, is highly useful for this purpose.

We can also employ in gilding or silvering drawings upon vellum or paper, *gold or silver inks*, of which we shall take the present opportunity to describe the preparation :—

*Gold Ink.*—We take leaves of gold, and add to them a sufficient quantity of white honey, to form a paste with them upon a grinding-stone ; and which is neither too thick, nor too thin. We then grind this paste with a muller, in the manner of grinding colours, until the gold is reduced to the greatest state of division possible. We remove this ground paste with a palette-knife, put it into a large glass vessel, and mix it with water. The gold, by its weight, falls to the bottom of the vessel, and the honey dissolves in the water ; we then decant it, and wash it with

more water, until the honey is entirely removed. We then dry the gold powder which remains at the bottom, and is exceedingly brilliant. When we would use it for writing or painting with, we grind it up with a solution of gum-arabic, and the ink is made. When dry, we may polish it with a dog's tooth.

*Silver Ink.*—This is made in the same manner as the gold ink, and used like it.

*Remarks by the EDITOR.*

*Gold or silver powders.*—It being difficult to grind so viscid a body as honey, a much better method of reducing gold or silver leaf to a fine powder, is to grind them with white or refined sugar, *in a dry state*, upon a stone with a muller, which very soon tears or reduces them to powder; after which, the sugar is dissolved in water, and washed away from the gold or silver powder in the manner above described.

*An excellent oil gold size to stand the weather.*—A celebrated mechanic of the Editor's acquaintance, who made church or turret clocks of a very superior description, was in the habit of causing the letters or figurers to be gilt upon their dials with a size, consisting of linseed-oil, kept in an earthen vessel, and covered with paper tied over its mouth for a number of years, the longer the better. A thick coat or skin formed upon the surface of the oil, but upon inserting the point of a palette-knife through the edge of the skin, the oil might be extracted from beneath it, and be diluted with spirit of turpentine, and mixed with yellow ochre for use; and thus forming a most durable size for the gold leaves to be applied upon in the usual manner of gilding.

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XVII.—*On producing the Moiré métallique\*.*

WE give this name to a varied crystallization, which exhibits itself upon the surfaces of tinned iron plates, when

\* From the *Dictionnaire Technologique*.

they are exposed to the action of acids. This crystallization pre-exists in the tin, and is only rendered manifest by dissolving the slight coat of tin which covers it ; it is easy to be convinced of this, by an attentive examination of a sheet of tinned iron, when placed in a bright light, and inclined in various directions ; we shall then perceive in the coat of tin certain parts which reflect the light diversely ; and it requires but little after this inspection, to know how to produce a species of *moiré*. It is therefore surprizing, that it should have been so long before any one thought of availing himself of a fact which had been known for so great a number of years. Indeed the discovery of the *moiré métallique* was only made in the year 1817, and was then said to have happened by chance. It is however certain, that this discovery, like many others, was signally distinguished by the contests, which its author, M. Allard, maintained, in bringing actions against a great number of tin-plate workers, who combined together to support each other ; and which ended in exposing the mystery of this new and beautiful art, which had excited the attention of all the curious. We shall now make known the manner of producing the *moiré*, and indicate the principle precautions which must be taken in order to succeed therein.

We have already said, that the *moiré* is constantly formed in the tinned iron plates, and only requires to be brought out ; but it requires still to be known, whether it results from a combination of the tin with the iron, or from a crystallization of the tin only. Many persons adopt the former opinion, and they form it, in part, on the fact, that the *moiré* is not perceptible upon the surface of the tinned iron, and does not exist but at a certain depth ; that is to say, at the point of contact of the two metals ; and that there is really a combination formed between them ; and they proceed to prove this kind of reciprocal penetration, firstly, by the numerous inequalities which are perceived upon the surface of the sheet-iron when the tin is removed by the action of a weak acid upon it ; and, secondly, from

the white colour of the section of the tinned iron, when cut by the shears. But it is to be remarked, that there is, no doubt, an illusion in these two circumstances, and especially in the last; as it is evident, that by the mechanical action exercised by the shears, the tin is torn off from the surfaces, and carried along by the cut in such a manner as to make it appear that the tin had penetrated to the centre of the iron; but if instead of cutting the tinned iron we break it across by bending it a number of times in opposite directions, we shall clearly see the colour of the iron and that of the tin. With respect to the inequalities upon the surfaces of the iron, which are rendered sensible by the action of an acid, we think that they are caused by the surfaces of the iron not being equally defended from the action of the acid by the same thickness of tin throughout; and that whilst the acid is attacking the last remaining coats of tin in those parts which were most thickly covered by it, it is also attacking the iron in the others, and thus producing the cavities which are remarked therein after the operation. It is necessary, therefore, in order to attain a perfect certainty in this respect, to employ a solvent which is not capable of acting upon the iron; thus, we may employ with advantage a bath of mercury, in which we may immerse the tinned iron, in order to remove the tin only. However, whether this supposed penetration takes place or not, or the combination be limited to the two surfaces in contact without penetration, it is by no means the less true, that the crystallization of the *moiré* is always due to the tin; and this is proved by the pure tin-foil affording these crystallizations. We do not, nevertheless, mean to deny, that more beautiful *moirés* may not be obtained by tinning the sheet-iron plates with alloys of tin, containing a little bismuth or antimony. It is nevertheless certain, that the English tinned iron plates, which are marked with the letter F, are best for the purpose; and it is said that their tinning is the most pure. These things being considered, we shall

now proceed to describe the process which must be followed in order to produce the *moiré*.

We have above said, that this process consists in corroding the surface of the tin by means of an acid liquor; but before communicating a considerable number of recipes, most of which may be used with equal success, we shall point out the necessary precautions to be observed. We must not lose sight of the fact, that the action of the acid must be exceedingly limited, and that it must not be carried beyond the removal of the thin pellicle which has been planished, either by means of the laminating rollers, or by hammering the sheets after they have been tinned. When the acid penetrates deeper, it will be liable to uncover the sheet-iron, whence there will result dark reflections or blacknesses in place of the silvery lustre and the pearly appearance of the tin. Thus the operator must direct his principal attention to the arresting the action of the acid, when it has been exercised the proper time; and we shall commence by giving instructions for its use.

We must prepare, on the one hand, a weak aqua regia, composed, for instance, of four parts of nitric acid, one of either of the muriates of soda or ammonia, and two of distilled water; and, on the other, we must have an earthen pan filled with water; then, by means of a small sponge, slightly moistened with the acid liquor, we wipe over the whole surface of the tinned iron plate equally, and which had previously been a little heated; when we see the reflections of the *moiré* manifested in a distinct manner, we instantly plunge the sheet into the water, and wash it either with the feather of a quill or a little cotton, but always in such a manner as to avoid using a degree of friction that might be capable of raising the small portions of tin which constitute the *moiré*.

We may readily conceive that the action will be more quick and lively in proportion as the acid employed shall be more concentrated, and the temperature elevated. We

cannot define the time necessary to be employed at each operation, as it will vary according to the influencing circumstances; thus the action may be terminated in less than a minute, or it may require more than ten minutes.

It is highly necessary to wipe the acid liquor quickly over the surface of the sheet of tinned iron, and not to pour it directly upon it, as the beauty of the *moiré* depends in a great measure upon an equal action being exercised over its whole surface; as, otherwise, it would be more brilliant in certain points than in others, and the iron might be exposed, and form black spots.

When the *moiré* has been properly developed, and the sheet has been well washed, so as to leave no remains of the acid employed, lest it should oxide and tarnish soon, we must dry it with care to avoid employing too great a heat, as in that case it would lose its lustre; and, in order entirely to prevent the ultimate effect of the air upon it, it may either be varnished immediately, which effectually secures it; or, in the mean time, be covered merely with a solution of gum, and which may afterwards be removed by means of water.

The different colours given to the *moirés* are owing to the coloured and transparent varnishes with which they are covered; and great care must be taken in using the pumice-stone, in order to render the coat of varnish thinner, that it be equally applied, so that the different reflections of the crystals be the better seen.

The too great malleability of thin leaves of tin after undergoing this species of crystallization, will not permit them to resist the heavy hammering to which we are compelled to have recourse in fashioning hollow bodies. And therefore we are obliged to employ them for plane surfaces, or at most for those which are but slightly curved, and which must be done with wooden mallets.

Each combination of these crystallizations in general, are susceptible of being modified by the influence of certain agents, and especially by that of heat. It is then not

### *On producing the Moiré métallique.*

absolutely the same thing in producing the crystallization of the *moiré*, and in modifying its grain, whether we destroy it in the whole or in part, according to the effect we would produce, and leave it to be reproduced by the influence of a cooling more or less prompt. When we expose for example, a sheet of tinned iron plate to a temperature sufficiently high to melt the tin; if we suffer it to cool slowly, the crystallization will nearly resemble that it possessed before heating it; but if the sheet, whilst hot, be suddenly plunged into cold water, the crystallizations will be all confused, and appear like a kind of sand. But if instead of effecting the cooling of the whole surface, we only partially effect it, by sprinkling cold water upon it, we can vary the crystallizations. We can also obtain similar results by blowing cold air upon the surface of the tin whilst it is in fusion, and at the moment when it begins to fix. Lastly, we can trace different outlines, characters, &c. by presenting to the surface of the tinned iron plate the point of a flame, directed by means of a blow-pipe. As the tin liquifies all along the course of the flame, and as in cooling it crystallizes in a different manner from that it originally possessed, so it results that the different designs may be varied in an infinity of forms. There are also other modes of varying the crystallization of the *moiré*, but we think we have said enough to guide any one; and we therefore leave to every one the satisfaction of creating novel modes of doing it.

We shall now terminate this article by indicating the different mixtures which we can recommend as being capable of affording a fine *moiré*; and we shall thus enable our readers to choose those which they can prepare with most convenience.

1. Two parts of nitric acid, one of muriatic acid, and two of distilled water.
2. Two parts of nitric acid, two of muriatic acid, and four of distilled water.
3. One part of nitric acid, two of muriatic acid, and three of distilled water.

4. Two parts of nitric acid, two of muriatic acid, two of distilled water, and two of sulphuric acid.
5. Four ounces of muriate of soda, eight ounces of distilled water, and two ounces of nitric acid.
6. Eight ounces of distilled water, two ounces of muriatic acid, and one ounce of sulphuric acid.

R.

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XVIII. *On Agenda, or Helps for Travellers, &c.* By  
the EDITOR.

THE traveller cannot possibly be possessed of too many helps, in a convenient and portable form, in his journeyings through foreign parts, and even in remote and unfrequented parts of his own country, where accommodations are difficult to be procured.

The Editor has long thought it would be a desirable thing to bring together, under one head, a number of useful hints and contrivances relating to this subject, which he has from time to time been in the habit of collecting or inventing; such as the following for instance:—

*A Portable Writing or Drawing Apparatus.*—The principal part of this exceedingly portable apparatus consists of a cylindrical tube, two inches in length, and two-tenths of an inch external diameter, the outside of it being fluted along it. Into each end of this tube another silver tube is fitted accurately, which is an inch and an eighth long, and swells or tapers a little from its ends towards its middle, where is a small ring or stop. One end of each of these tubes is open, and one of them contains a crow-quill pen, and the other a camel's hair pencil. Their other ends are occupied by a writing diamond, and a pencil of the *fusible metal*, for writing or drawing upon thick paper, rubbed over on both sides with prepared hartshorn, or levigated bone-ashes, and which thus forms what is termed *velvet paper*. Upon the outside end of one of the tubes, a steel pen is slipped, with its point turned inwardly; but

when taken off, and again slipped on the contrary way, is fit for writing with as usual. Thus this small apparatus contains five different and very useful implements; namely, a crow-quill pen, a steel pen, a camel's-hair pencil, a metallic pencil, and a writing diamond; the crow-quill pen, and the camel's hair pencil, being inside the tube. It should be observed, that the two short tubes are each capable of being reversed, or fitted into the outer tube in opposite directions, being stopped in the middle against the small ring abovementioned. This apparatus is very conveniently carried in a thin hard-wood cylindrical case, four inches long, and five eighths in diameter, each end of it being rounded; and which contains other small and useful articles within it.

*The ink for writing or drawing with*—Is either Indian ink rubbed over the two internal surfaces of a piece of doubled asses-skin; or an excellent substitute for it, which may be made at any time, or any where, simply by holding an earthen plate or dish over the flame of a lamp or candle, and receiving the smoke produced by either of them upon the surface; and which only requires to be mixed with a little weak size, or common carpenter's glue, and water, by wetting the brush with it, and washing and mixing it amongst the lamp-black uniformly; and in this facile way may an ink be formed, capable of fully answering all the purposes of the best Indian ink; and some of it may be transferred, with the camel's hair brush or pencil, either to the two leaves of asses-skin, or portable palette before described, or to the crow-quill pen, and thus we may have it in our power to write, draw, or shadow at our pleasure.

The steel pen, although not quite so pleasant to write with as one formed of quill, is nevertheless a convenient instrument to have at hand at all times; and, of course, may be used with common ink.

*On the proper kind of Writing Paper for Travellers' use.*—The Editor was informed by the late Mr. Farey, the

author of the Mineralogical Survey of Derbyshire, that he found Whatman's thin wove bank post writing paper greatly superior to any other kind for travelling purposes, as from its great thinness it might be creased or crumpled without ever cracking, as paper usually does under such circumstances, a most valuable property indeed, and he had found the greatest benefit from it in taking his extensive series of notes for the above valuable work. The Editor finds it convenient to cut the large sheet of this paper, which is generally cut crossways, and formed into two sheets of letter paper, lengthways into two pieces, each being about twenty inches long, and eight inches broad; these he doubles in the middle of their lengths, and then he again subdivides those parts, each being folded inwards in the same direction; he then divides each of these four primary divisions into two others, by folding them the contrary way to the former ones, and thus forms both sides into eight pages or columns, making sixteen in all, and bent like the folds of a fan, backwards and forwards alternately; and when shut up being about two and a half inches wide, and eight inches high. These columns he pages thus: he marks the front page 1, then that on the back of it 2, and so on to 9, on that side of the paper; he then turns it over, and marks the first or left hand column on that side 10, and proceeds to the 16th column, which finishes it. He also reserves the back outside page 10, for the purpose of entering the contents of the whole sheet. And, finally, marks each sheet with a different letter of the alphabet, for the sake of easily referring to it when necessary. In this mode of folding the sheets all stitching or binding is avoided, and a number of them can be carried in a bill or note case with great convenience on a journey; and when opened and expanded, the whole contents of the eight columns of writing, on either side of the sheet, are visible at once, which is a great convenience in many cases, and more especially if the drawings, which may occasionally be made to extend over several columns, are

also interspersed among the writing, as they lead the eye at once to the subjects of them; and indeed it is well worth the while of any one preparing for a journey to places where many things are likely to be found worthy of recording, to provide himself with this simple and convenient way of doing so. The crow-quill pen enables us to commit many particulars to writing, within the limits of even a single sheet; and the Indian ink, or the Editor's complete substitute for it, can always be carried with great convenience, which is by no means the case with fluid ink, as it will unavoidably be continually liable to escape from the bottles, fountain pens, or whatever other contrivances it may be enclosed in, and do great mischief to any papers, writings, &c. which it may come in contact with. Neither is the Indian ink or its substitute likely to fade or become pale in the progress of time, as is the case with the fluid inks in general use.

*On a parchment case or envelop to contain the above described sheets of writing-paper.*—This may be made as follows, and for the contrivance of it the Editor is indebted to the scientific Mr. Mylne, of Edinburgh:

Provide a piece of stout parchment, fifteen inches long, and ten and a half or eleven inches wide; fold this lengthways into three equal divisions, of three inches and a half each, shutting or folding upon each other; and likewise turn in three and a half inches upon each side of it, and cut away a square piece out of two of the corners, each of three and a half inches wide. Then form two diagonal creases in each of the turned in ends, bent in the contrary direction to the others folds, or inwardly from the middle internal divisions, and reverse the middle creases, turning them outwards, so that when turned inwardly, these two-thirds of the parchment form a pocket, separated into three at each end of it, by the intromission of these two sets of diagonally creased parts, and in a manner that is quite sufficient for keeping the papers apart. The remaining portion is to be formed into a flap, which shall shut over the

pocket, and retain its contents securely ; this is effected by merely cutting it into a rounding form. In this very facile manner is a parchment case or envelop formed without the aid of stitching, cementing, &c., as usual in pocket-book making, and which is yet sufficient for the intended purpose, and especially if we likewise provide a band of parchment, two inches in breadth, and its ends united together by stitching or cementing them, to slip over and keep the envelop closed ; and indeed the Editor constantly carried one of them in his pocket for several years, and even until its corners were quite worn through ; and yet without the papers it contained suffering in any considerable degree.

(To be continued.)

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XIX.—On Guyot's Preservative Liquid for Animal and Vegetable Preparations.

TOWARDS the end of the last century, the French government printed and published a considerable number of instructions on "*The Art of registering and preserving the Objects serving for the elucidation of the Arts, Sciences, and Education*," which, however, are now but little known or attended to ; and, in consequence, many fine preparations having fallen into the hands of persons but little acquainted with the simple and facile methods of preserving them there described, are rapidly hastening to decay. In consequence, the society of learned men who edit the *Dictionnaire Technologique*, have thought it desirable to re-publish in that respectable work some of the chief instructions relating to this interesting object ; and from which we extract the composition of this preservative liquid, and the manner of using it, as follows :—

*The preservative liquid invented by Guyot*, which may be used with great success in the preservation of vegetable and animal preparations, deserves the highest considera-

tion. We think that we shall benefit the public by giving the process for preparing it, which is by no means sufficiently known.

Take twenty litres\* of the best brandy, and draw off from it, by distillation, five litres of alcohol; then add to the remainder an equal quantity of spring-water, and a pound of the flowers or leaves of lavender, and distil it anew to dryness. This done, we take nine parts of the alcohol drawn off in the first distillation, and mix it with sixty-nine parts of spring-water; and then add to the latter mixture an equal quantity of the liquid obtained in the second distillation. We thus form Guyot's preservative liquid, which possesses great clearness, has a taste of almonds, and a slight aromatic smell; and as it only contains about a thirteenth part of alcohol, so it is by no means expensive.

In using this liquid, the bottles containing the preparations may either be tightly closed with corks which have been steeped for some time in a composition of three parts of wax and one of suet, melted at a temperature not liable to burst or swell the corks. The mouths of the bottles are thus closed with flexible stoppers, the pores of which are rendered impenetrable, and thus prevent all evaporation of the fluid contained in the bottles. Or the mouth of each bottle may be closed with a flat plate of glass, fitted to it accurately; the mouth itself having also been previously ground truly flat, by rubbing it upon a flat plate with emery and water; and around the joining may be placed a band of paper soaked in drying-oil; or this oiled paper may be covered with laminated lead, over which may be tied, with a thin pack-thread, a piece of parchment, coated with drying-oil mixed with lamp-black; the twine being drawn as tight as possible. By taking these precautions we may hinder all evaporation.

*Remarks by the Editor.*—We think the method of

\* The litre is equal to 61.02443 English cubic inches.

closing the mouths of bottles containing anatomical preparations preserved in alcohol mixed with water, as practised by the late Mr. Taunton, an eminent surgeon of this metropolis, and a lecturer on anatomy, preferable to either of the above ; it was as follows :—

He fitted to the mouth of the jar or bottle a thin circular plate of laminated lead, by laying it upon the mouth, and pressing it with his hand all around, in order to receive the impression of the exact form of the mouth upon the lead, and which he then cut to the shape with scissars, leaving it, however, rather larger than the mouth. He then applied a little lard around the mouth of the jar, and fitted the lead over it, burnishing its edges close down all around it. He then covered the lead with a piece of bladder which had been macerated in water until it had become gelatinous in consequence of incipient putrefaction, and tied the bladder closely all over and around the neck and mouth of the jar or bottle with twine. He then let it remain to dry, when he removed the twine, the bladder having cemented itself fast upon the bottle by its own gelatine. Lastly, he completed the security of the closure by painting the bladder all over with a black oil-colour, having previously trimmed away with his scissars the excess of the bladder below the tied part. In this way, he found that the liquid contained in the jars or bottles was effectually secured from escaping.

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XX.—*On Bleaching Sponge.* By M. VOGEL, of  
Munich\*.

ALTHOUGH sponge in its chemical nature very much resembles silk and wool, yet it cannot be bleached in exactly the same manner as those substances. M. Vogel was con-

\* From *Archive fur die gesammte Naturlehre*; translated in the *Franklin Journal*.

vinced that the bleaching of it would be more difficult, as the action of the vapour of burning sulphur upon it reduces it so considerably, or, as we may say, almost to nothing; whilst both silk and wool, as is well known, are bleached by this means in a most complete manner. The finer the sponges the more easily they are bleached. The following method has succeeded extremely well for this purpose:—

The sponges must first be sufficiently steeped in cold water; for if they were to be put into either boiling or even warm water, it would produce a most destructive effect upon them; as they would shrink, their pores would be closed, they would become hard, and it would be impossible to bleach them afterwards.

But if the sponges were steeped in cold water, which should be changed every three or four hours, and if at each time they were changed they were submitted to so strong a pressure as to be entirely freed from the water, at the expiration of five or six days they would become sufficiently washed, and be prepared for the bleaching.

If, as it frequently happens, the sponges retain in their interior small calcareous stones, which it might be supposed could not be extracted without tearing or beating them to pieces; yet, it is easily effected by allowing them to steep for twenty-four hours in muriatic acid, diluted with twenty parts of water; this produces a slight effervescence from the extrication of the carbonic acid gas; and the calcareous concretions disappear, being dissolved in the most complete manner.

Then, after having been very carefully washed, the sponges are thrown into a solution of sulphurous acid of the specific gravity of 1.024; or, which marks about 4° on the areometer of Beaumé. The following is the best method of preparing this acid:—

Put into a glass retort one pound of pulverized charcoal and one pound of concentrated sulphuric acid, and, by

means of a bent tube, convey the gas which is extricated into a vessel, where it may be combined with about eight pints of water, according to the Bavarian measure\*.

The immersion of the sponges in this acid is to be continued for eight days, but during this time they are to be repeatedly submitted to the action of a press; and, lastly, they are allowed to remain twenty-four hours in running water.

When the sponges have thus been washed in a sufficient quantity of running water, they may be sprinkled with rose or orange-flower water, for the purpose of communicating to them an agreeable odour; after which, they may be allowed to dry gradually in the open air.

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## XXI.—MISCELLANEOUS.

*On South American Metallurgic Processes.*—Captain T. M. Bagnold, who has lately returned from South America, informed the Editor that the Indians are in the habit of separating the precious metals, gold and silver, from their ores by means of mercury, with which they triturate them; and that after squeezing out all the excess of mercury from the amalgam, through leather, in the usual manner, they finally separate the last remaining portion of it from the mass as follows:—

They put water into a proper vessel, and place in the middle of it a piece of brick or stone, which rises above the surface of the water, and upon this block they lay a plate of iron, heated red-hot, and the lump of amalgam on the centre of that plate. They then cover them over with an inverted earthen pot, the rim of which is immersed in the water; and thus the mercury sublimes, is condensed in

\* It might probably answer the purpose to combine the gas first with two pints of water, and afterwards to dilute the acid with six pints more, when it is to be used for bleaching the sponges.

the water, and again collected for use, in this very simple manner.

When they have larger masses, they mould them into the form of sugar-loaves, and place them upon a plate of iron perforated with holes all over it, and underneath it they put a vessel containing water. They then cover the masses of amalgam with an inverted vessel, the edges of which are well luted to the iron plate, and make a fire all over it. In this manner the mercury is separated and condensed in the water by that process of distillation termed *per descensum*.

The Indians are much in the habit of committing frauds upon the purchasers of these masses of the precious metals ; sometimes they inclose a lump of lead within the mass of amalgam ; and even in ingots of them a bar of copper has frequently been found in the middle of the precious metal ; so that it becomes the dealers with them to be very circumspect in their purchases, and even to cut the pieces asunder to see their interior.

*Dissertations on subjects connected with the arts and manufactures of this country.*—The Society of Arts, &c. Adelphi, having taken into consideration the advantages that would probably accrue from occasional meetings for dissertations on subjects connected with the arts and manufactures of the country, illustrated by ancient and modern specimens, have determined to appropriate seven evenings during the present session for this purpose, viz.—On Tuesday, Jan. 27th ; Feb. 10th and 24th ; March 10th and 24th ; and April 14th and 28th. The meetings to commence at eight o'clock, when each member is also allowed to introduce his friend.

Ancient and modern pottery and porcelain will occupy the first two evenings ; and the subjects proposed for illustration on the others, are the arts of stereotype founding and printing, and of casting in plaster of Paris ; and the manufactures of glass and paper.

The preparation of the Essay to be read on each evening has been confided to the Secretary, who will be happy to receive either written or verbal communications illustrative of any of the above subjects.

It is evident that much of the interest and instruction expected from the proposed meetings will depend on the abundance and quality of the specimens by which each subject will be illustrated. Applications have already been made to several individuals, both in and out of the Society, and the uniform liberality with which they have been met, is a gratifying proof of the interest taken in the plan; and a presumption, that other members of the Society, and other persons also, will be equally willing to contribute curious and interesting specimens and particulars, either directly or more remotely connected with the topic of each evening's discussion.

The Society will also feel obliged by the loan of any articles that will add to the interest of these meetings. Characteristic specimens of natural substances, especially of those that form the raw materials of the arts and manufactures of the country; tools, instruments, and models of machinery; samples of new and beautiful fabrics, fine works of art, books, and prints, will be particularly acceptable. It is requested that all such articles may, if possible, be sent the day before the meeting, in order that they may be properly arranged.

A. AIKIN, Sec. Dec. 22, 1828.

These dissertations commenced, agreeably to the above notice, on Tuesday evening last.

*On the Preparation of Artificial Ultramarine.* By M. GMELIN, Professor of Chemistry at Tubingen\*.—We take the hydrates of silica and alumine, obtained by the usual means, and well washed in boiling water; we then determine, by desiccation, the weight of real oxides which

\* From Ferussac's *Bulletin des Sciences Technologiques*.

they contain. The silicate here employed contained fifty-six parts in the hundred, and the alumine only 3.24. We then dissolve, in a hot and aqueous solution of caustic soda, as much of the hydrate of silica as it can take up, and ascertain the quantity dissolved. Then, supposing that seventy-two parts of the anhydrous silicate had been employed, we must add seventy parts of alumine in the same state. We then evaporate it, with constant stirring, until a humid powder only remains.

We then put into an earthen crucible, to be exactly closed by a well-fitted cover, a mixture of two parts of sulphur and one part of carbonate of soda, well dried, and deprived of its water of crystallization, and gradually heat it until the mass is in tranquil fusion; we then throw in, by small portions at a time, the mixture of alumine, silicate, and soda, into the midst of the fused mass. When the crucible has remained for an hour exposed to a moderately red heat, it must be removed from the furnace and suffered to cool. It now contains ultramarine with an excess of the sulphuret, which is to be removed by washing with water. What sulphur is nevertheless not combined, and still remains in the mass, is then to be dissipated by a gentle heat. Finally, if all the parts of it be not uniformly coloured, the best parts may be separated, after grinding it fine upon porphyry, by washing over with water.

*Remarks.*—In page 52 of the last volume, will be found a notice by M. Gay Lussac, that a M. Guimet had lately manufactured every kind of ultramarine by following the analysis made by M. Clement Dèsmores.

## LIST OF PATENTS FOR NEW INVENTIONS,

*Which have passed the Great Seal since Dec. 22, 1828.*

To William Parr, of Union-place, City-road, in the county of Middlesex, gent.; and James Bluett, of Blackwall, in the said county of Middlesex, ship joiner, mast and block maker, and pump maker; for a new method of producing a reciprocating action, by means of rotatory motion, to be applied to the working of all kinds of pumps, and other machinery, in or to which reciprocating action is required, or may be applied. Dated Dec. 22, 1828.—To be specified in two months.

To George Rodgers, of Sheffield, in the county of York, cutler; Jonathan Cripps Hobson, of the same place, merchant; and Jonathan Brownill, of the same place, cutler; for certain improvements in table forks. Dated Dec. 23, 1828.—In two months.

To Orlando Harris Williams, of North Nibley, in the county of Gloucester, esq.; for certain improvements in the paddles and machinery for propelling ships and other vessels on water. Dated Jan. 7, 1829.—In six months.

To Septimus Gritton of Pentonville, in the county of Middlesex, surgeon, and late of our royal navy; for an improved method of constructing paddles, to facilitate their motion through the water. Dated Jan. 7, 1829.—In two months.

To Francis Neale, of the city of Gloucester, barrister at law; for a machine, apparatus, or combination of machinery, for propelling vessels. Dated Jan. 7, 1829.—In six months.

To James Deakin, and Thomas Deakin, of Sheffield, in the county of York, merchants, and manufacturers of hardware, and partners; for certain methods of making from horns and hoofs of animals, various articles, namely, handles of knives, handles and knobs of drawers, and other parts of cabinet and household articles, curtain rings, bell pulls, door handles and knobs, key-hole escutcheons or coverings, and door and window-shutter finger-plates, knobs, and handles; all or any of which articles are to be so made of one or more piece or pieces of horn or hoof, of any shape or device, plain, or ornamented, or inlaid, or conjoined with any kind of metal or other materials. Dated Jan. 14, 1829.—In two months.

To William Taft, of Birmingham, in the county of Warwick, harness maker, saddler, and bridle cutter; for certain improvements in, or additions to, harness and saddlery, part or parts of which improvements or additions are also applicable to other purposes. Dated Jan. 7, 1829.—In six months.

To Archibald Robertson, of Liverpool, in the county of Lancaster, ship carver; for certain improvements in the construction of paddles for propelling ships, boats, or vessels, on water. Dated Jan. 7, 1829.—In six months.

To John Dickinson, of Nash Mill, in the parish of Abbots Langley, in the county of Hertford, paper manufacturer; for a new improvement in the method of manufacturing paper by machinery, and also a new method of cutting paper and other materials into single sheets or pieces, by means of machinery. Dated Jan. 14, 1829.—In six months.

To Thomas Smith, of the borough of Derby, in the county of Derby, engineer; for an improved piece of machinery, which, being combined with parts of the steam engine or other engines, such as pumps, fire engines, water wheels, air pumps, condensers, and blowing engines, will effect an improvement in each of them respectively. Dated Jan. 14, 1829.—In six months.

To Church Hews, of Manchester, in the county of Lancaster, engineer; for various improvements in the form and construction of windmills, and their sails. Dated Jan. 14, 1829.—In six months.

To John Uldney, of Arbour-terrace, Commercial-road, in the county of Middlesex, esq.; for certain improvements on the steam engine. Dated Jan. 14, 1829.—In two months.

To William Erskine Cockrane, of Regent-street, in the county of Middlesex; for an improvement in or on paddle-wheels, for propelling boats and other vessels. Dated Jan. 14, 1829.—In six months.

To James Moore Ross, of Symonds-inn, in the county of Middlesex, ironmonger; for an improved tap or cock for drawing off liquids. Dated Jan. 19, 1829.—In two months.

GILL'S  
TECHNOLOGICAL & MICROSCOPIC  
REPOSITORY.

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XXII.—*On the Microscope.* By the EDITOR.

WITH FIGURES.

(Continued from page 80.)

*On a British Scolopendra or Centipede.*—This insect was found by Mr. Thomas Carpenter lying under a piece of tile in his garden. He kept it for several days under a wine-glass, when it nearly lost its opacity, and became more transparent. After killing it in his usual speedy manner, by putting it into boiling water, he secured it between two slips of glass; and, on placing it under his microscope, he was quite astonished at the display of the large and small blood-vessels, and other parts of its interior, which were distinctly seen ramifying in every direction, throughout the whole length of the insect. The curious manner in which the two main trunks of the arteries serpentine or bend so as to allow of the greatest freedom of motion in the numerous joints of its body, without straining or injuring them, is well worthy of observation; and, accordingly, we have represented a portion of the insect in fig. 1. of plate III., where the main trunks of the arteries are seen to approach each other in the centre of the body, and then to recede again towards the sides of it; the points of union being, as above-mentioned, at each of the numerous joints or articulations which extend along the entire

length of its body, so as readily to allow of the continual bending and twisting motions of the insect taking place in its progress. The whole insect is not much more than an inch in length, and yet it seems to be furnished with as many parts as the larger kinds which are found in hot climates. One from Africa is to be seen in a cabinet of the British Museum, which measures nearly eighteen inches in length ! The bites of these larger species are very venomous, and indeed often prove fatal ; and it is no uncommon occurrence, in the warmer climates, for persons, on stepping into their beds, to find them occupied by these formidable insects ; and it is therefore necessary to place the feet of their bedsteads in vessels of water, in order to prevent their being annoyed by them in the night. It is even supposed that the very claws upon the numerous feet of these reptiles are armed with venom ; but its most formidable weapons are two sharp fangs, or hooked instruments, which are placed under its mouth, and with which it destroys its prey. At the extremity of each of these fangs is a small opening, through which it is supposed that the centipede emits a poisonous fluid into the wounds inflicted by them.

*On the compound threads spun by the garden spider.* These are the threads so much valued by the astronomical observers, when placed in the micrometers of their telescopes. One of these threads, collected by Mr. Peter Keir, of Camden Town, and intended for this purpose, was given by him to Mr. T. Carpenter, who carefully mounted it between two slips of glass ; at the same time also inserting by the side of it a human hair, to serve as a finder to the spider's thread ; and their appearances, as transparent objects in his microscope, under the same magnifying power, are represented in figs. 2 and 3, of plate III. ; the first showing the spider's thread, as being in reality composed of five threads, placed side by side, in a perfectly parallel manner ; and the other exhibiting the human hair, as being of a cylindrical form, and covered all over with scales or roughnesses.

*On the hair and fur of the South Georgian seal.*—These were removed from one of the seal-skins, in the exportation of which, the citizens of the United States carry on so great a trade with China, bartering them for teas, &c. The Chinese dye these skins of a great variety of colours, and form them into articles of wearing apparel. Both the hair and the fur are of a flattened form, they not being cylindrical, but rather of an oval shape in their sections. Their beauty, however, as microscopic objects, arises from their being covered with scales, arranged in regular order, as shown in figs. 4 and 5, of plate III.; and which are drawn from specimens in the Editor's collection of microscopic objects, they having been presented to him by a deceased friend nearly thirty years since. Fig. 4 is part of a hair, and fig. 5 of a fibre, of the fur, both being magnified in the same proportion; and fig. 6 is a section of the hair. Besides the beautiful and well-defined scales with which the hair is covered, there is an appearance in the middle of it somewhat resembling the pith in the interior of a quill; and the scales covering the fur, must, undoubtedly, most admirably fit it for undergoing the *felt*ing process in hat-making.

*On the curious structure of the tongue of the house-fly, when viewed as a transparent object.*—In our last volume, page 327, we pointed out to the notice of our readers, the beautiful structure of the end of the tongue of this fly, as exhibited in a specimen of the Editor's, mounted as a transparent object between two slips of glass; at the same time we stated that the artist, from its complexity, despaired of doing justice to it, in any representation of it he might have attempted to make. Since then, we have found in Mr. T. Carpenter's extensive collection of microscopic objects, another preparation of this object, in an expanded or cleft state, which has considerably lessened the difficulty of delineating it; as the parts, which in the Editor's object are doubled, owing to their lying the one upon the other, and thus producing the complicated

though beautiful appearance it makes, are in Mr. Carpenter's only single, and are, in consequence, capable of being more easily delineated.

In plate III., fig. 7, is a representation of this singular structure, magnified upon a large scale; and in which will be seen the curious arrangement of the parts which contribute to give the requisite motions to it in performing the various operations of sucking, &c. for which it is designed; as likewise the strong hairs with which it is provided, and the muscles by which it is thrust out of the mouth of the fly, and again retracted. The structure of the parallel rows of curved lines, proceeding on each side from the centre of the tongue towards the sides of it, greatly resembles that of the blood-vessels in other parts of the insect; they being, like them, coated all over with crossing-lines. The external appearance of this part of the tongue, as an opaque object, was given by us in fig. 19, of plate II., contained in our last number.

Besides the sucking action of the tongue, Mr. T. Carpenter has recently found, that it has likewise the power of piercing through the skins of fruits, &c., upon which it preys, by means of a short part, or a strong proboscis, which projects out from underneath the tongue, and is furnished with stout supporting branches and muscles; and thus prepares the way for the tongue, in its turn, to perform its office of conveying the exuding juices from the aperture made by the piercer, into the mouth of the fly.

*On the singular apparatus of a field cimeter.*—In plate III. fig. 8 represents this apparatus as proceeding from a flexible organ, somewhat resembling the trunk of an elephant, attached to the head of the insect. It consists of a stout piercer, and two flat and slender appendages, which are well adapted to the purpose of opening the pores of the plants which it inhabits; and it feeds upon the juices proceeding from the apertures made by the piercer and its appendages.

On viewing this object lately in Mr. T. Carpenter's com-

pound microscope, the Editor perceived a semi-transparent appearance in the sides of the two appendages to the piercer; and on viewing it under considerably higher magnifying powers, he found them to possess the curious structure shown in fig. 9, which represents a minute part of one of them greatly magnified; and in which it will be seen, that it has a thin web attached to a thicker part, and that the edge of this web is serrated all along it. The points of these two appendages are toothed or jagged in a more marked way, and as shown in fig. 10. Mr. T. Carpenter believes, that the curved forms of the ends of these appendages were caused by their shrinking or contracting in drying, and that they are naturally straight in their living state.

Mr. Carpenter states, that the genus *cimex* is a very extensive one, it comprising upwards of eight hundred species; and that they inhabit plants, which are as various as the shapes and colours of the cimices themselves. Some of them possess colours which are brilliant beyond description (as, indeed, the Editor has had the pleasure of seeing in Mr. Carpenter's collection). In their larva state they are very active, and differ but little from the perfect insects, as they only want wings. They overrun the plants, grow, and change into crysalids, or pupa, without appearing to undergo any material change. They have indeed only the rudiments of wings, which their last transformation unfolds, and the insect is then perfect. In their two first stages they are unable to propagate their species. In the perfect state, the fecundated female lays a great number of eggs, which are often found upon plants, placed side by side. Many of these eggs, when viewed through a magnifier, present singular varieties of conformation. Some are crowned with a row of small hairs, others have a circular fillet, and most of them have a piece appended to them, which forms a cap: this piece the larva pushes off when it forces open the egg. Released from their prison, they overspread the plant, on which they feed; each ex-

tracting, by the help of its rostrum or proboscis, the juices appropriated to its nourishment. Even in this early state the larvæ are not peaceably disposed, for some of them are voracious in an eminent degree, and spare no insect which they can overcome. In their perfect state they are mere canibals, and destroy caterpillars, flies, and even some of the coleopterous or beetle tribes, whose hardness of elytra, or wing-cases, one would have imagined, were proof against their attacks; and yet they fall an easy prey to the sharp piercing powers of the instruments which are lodged in the proboscis of the cimex; and even the incautious entomologist may experience the painful severity of its attack! The instruments displayed in our figure, and taken out of the proboscis, are well adapted for opening the pores of plants.

*On the teeth of the tad-pole.* In our second volume, page 59, we mentioned, that Mr. T. Carpenter had a set of these very delicate teeth, beautifully displayed as a microscopic object. On a recent visit to him, we caused our artist to make a drawing of one of the jaws and its teeth, and which we now give in plate III., fig. 11; from which it appears, that it is not only toothed upon its edge, but that there are also other rows of teeth upon the face of the jaw.

*On the scale of a foreign species of cabbage butterfly.*—Mr. William Tulley, the son of that excellent optician, Mr. Tulley, of Islington, has lately presented Mr. T. Carpenter with specimens of these scales, which differ from those we have before given, in having no cleft part at their base, although they are furnished with the circular part and its stem, by which they are attached to the wing of the butterfly, and as shown in fig. 12, of plate III.; as well also as the tuft of fibres with which they are furnished at their opposite ends. These also form tolerable test objects for the microscope, although their delicate linear markings are not near so difficult to discover as those of the scale of the butterfly of the brassica, given in plate IV., fig. 5, of

our last volume. And we may here remark, that in other specimens of this latter scale, in Mr. Carpenter's possession, the circular part and its stem, which seems peculiar to these scales, are likewise to be found, although they were wanting in the specimen from which our figure was delineated.

Mr. William Tulley likewise furnished Mr. Carpenter with the very curious scales of a butterfly, resembling in form a cut glass goblet without its foot; and one of which we gave in fig. 30 of our last plate.

*On the blood-vessels attached to the plates forming the body of the house-fly.*—In our second volume, page 260, we mentioned Mr. T. Carpenter's great success in preparing beautiful opaque objects of these for his microscope; and likewise in plate VI., fig. 5, we gave a view of one of the plates. Since then, he has succeeded in obtaining more extensive combinations of these plates, in which the ramifications of the blood-vessels are seen extended over them in a beautiful manner, even in their dried state, although they must certainly have appeared far more beautiful in their recent or moist state.

*On the dissected proboscis of a small musca.*—In plate III. fig. 13 is a representation of this microscopic object as prepared by Mr. T. Carpenter. It consists of four parts, the two external ones being pointed, and furnished on their edges with hairs pointing backwards, and the inner ones adapted for sucking the juices of the plants which the musca feeds upon.

*On the elytra or wing-cases of the furze cimez.*—This insect is not larger than a flea, and yet the beauty displayed in the structure of its wing-cases is most admirable. In plate III. fig. 14 is a magnified view of one of them, drawn from a transparent object in Mr. T. Carpenter's collection, and in which its singular construction is apparent.

Mr. Carpenter was in the habit of furnishing his friend, the late Mr. Kimball, an eminent optical glass-grinder, with specimens of these in particular, and other elytra, as

microscopic objects; and which he mounted as choice and select subjects, in the ivory sliders he fitted up.

*On a red murine conferva, from Van Dieman's Land.*—Mr. T. Carpenter was furnished with this most exquisite microscopic object by R. Brown, Esq. of the British Museum, and he afforded the Editor a high gratification lately, by favouring him with a sight of it, mounted between two slips of glass, as a transparent object. It would have afforded him much pleasure to have given a delineation of it in the plate accompanying the present number, but the extreme delicacy and minuteness of its structure prevented it. Possibly, now that Van Dieman's Land is becoming colonized, other species of this beautiful conferva may be sent to this country, and thus render it more accessible to the admirers of the microscope; at present we must content ourselves with merely pointing it out to the notice of our readers.

*On Mr. T. Carpenter's additional microscopic dissections of the black domestic beetle.*—Encouraged by the great success attending his former dissections of this insect, as repeatedly noticed by us in our last volume, he has recently extended his researches into the structure of its interior, as well as its exterior, parts.

The preparations first made by him, and secured between two slips of glass, in the manner described by us, such as the coats of the stomachs for instance, have not hitherto suffered the least change, nor are they likely to undergo any alteration or decomposition in the time to come.

He has since then cleared out the interior of the crustaceous parts or shell of the insect, and has found its whole surface to be covered over with numerous arteries, veins, muscles, &c., ramifying in every direction. These he has preserved between two slips of glass, and they remain permanent, and exhibit the parts in a very superior manner, either as transparent objects, or as opaque ones, when a slip of blackened card is placed beneath them; and they are illuminated by means of the silver concave speculums,

which are fitted to the object glasses of his compound microscope, in the manner formerly described by us, and which reflect the light upon them:

He has likewise succeeded in making a most beautiful preparation of a skin or apron, which he has extracted from the abdomen of the female beetle; and after cleaning and extending it, has secured it between glass slips. This is full of blood-vessels, presenting an appearance fine beyond the power of description, or the ability of an artist to delineate.

*On the volvox globator.*—Mr. T. Carpenter having procured a number of these singular animalculæ from a pond belonging to a friend of his, laid some of them upon a slip of glass, and suffered them to become dry thereon. These he covered and defended, by cementing another slip of glass over them in his usual manner, and recently favoured the Editor with a sight of them under the power of his microscope.

These presented an appearance resembling that in fig. 15 of plate III., where a larger one is seen still containing others within it; and again, some of a lesser size, which had escaped from within the larger one, and yet contain others inside them; whilst several of these smallest occupied other surrounding portions of the field of view; and thus the three generations of this singular animalcula were all exposed at once.

These animalculæ afforded one of the chief objects exhibited in Mr. Philip Carpenter's achromatic solar microscope in Regent Street last year; where the larger ones were magnified to the size of a foot in diameter, and continued in motion perpetually, revolving around their axis, at the same time they were ascending and descending in the water containing them. He had also another set of them exhibited in his microcosm, or extensive collection of large lucernal microscopes; and upon adding some of the minute eels in paste to them, it was curious to observe several of them at once wriggling within the bodies of the

*valvæ globator*, and accompanying them in their movements through the water.

We hope to be still more gratified by this beautiful exhibition this present year, as Mr. P. Carpenter has, in his new arrangement, considerably extended the field of view in his solar microscope, as well as rendered his microscopium entirely independent of all changes of the weather, as the principal part of the objects, and, when necessary, the whole of them, are illuminated.

*On Mr. Bate's improved lenses.*—Mr. Bate jun. of the Poultry, has recently managed to form a stop or diaphragm in the centre of a double convex lens, to cut off the extraneous rays of light, without making a combination of two plano-convex lenses, with their plane or flat sides turned inwards, and having a plate of metal with a hole in its centre placed between them, as recommended by the late Dr. Wollaston; and he has thus avoided the creating of two additional plane surfaces to grind and polish.

He has effected this important object in the following manner:—The lens being firmly cemented and centered upon the end of a chuck in his lathe, he grinds a circular groove or furrow all round its edge, by means of a thin plate or web of copper, held in a frame in the manner of a saw to keep it stretched tight, and the application of emery water: this groove he makes so deep, as to approach near to the centre of the lens, only leaving so much solid glass remaining, as is sufficient to permit enough light to pass through the lens, when the groove is filled up with black wax. The lens so prepared, appears in its section similar to fig. 16 of plate III., and its performance is good.

*On additional crystals formed in the mixture of salts, termed by the Editor the "Microscopic Kaleidoscope."*—Since our last number, the Editor has found, in pursuing his experiments upon this subject, that the crystals shown in figs. 17, 18, and 19 of plate III., have formed themselves in the drop of fluid: these crystals are evidently modifications of those given in figs. 9 and 10 of plate II.

*On Goring and Pritchard's new work, On the Microscope.*—We have to congratulate the admirers of the microscope, on the appearance of the first number of a quarterly publication, expressly devoted to the natural history of living objects for the microscope, with descriptions of the latest improvements in the diamond, sapphire, aplanatic, and Amician microscopes, and instructions for managing them; illustrated by highly finished engravings, from drawings of the actual living subjects.

The present number contains engravings of several larvae, and in particular that of the ephemeron fly, beautifully executed; and indeed such expensive engravings can only be given in high priced works like this we are describing. We trust, however, that the encouragement of the public may prove sufficient to enable the editors to continue a work so well commenced; and thus we shall be put in possession of engravings, from drawings, which it must have cost infinite labour and perseverance to have produced.

(To be continued.)

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**XXIII.—*On Agenda, or Helps for Travellers, &c.* By the EDITOR.**

(Continued from page 119.)

*Another exceedingly portable parchment case or envelop, to contain writing paper, a pen-holder, and a silver pencil.*

—This is a still more compact mode of carrying a supply of writing paper, a pen, and a silver pencil, although perhaps not in so convenient a way for use as that described in page 118. Where, however, bulk is objectionable, this form may deserve a preference, as the whole is comprised in a parchment cylindrical case, of only four and a half inches in length, and five-eighths of an inch in diameter!

This method was practised by the Editor twenty years ago, and before he adopted that before described. *The*

*paper* was the *thin* quarto bank post letter paper, cut into portions, of four and a half inches in width, and fourteen inches long. Each of these was folded across in the middle, and then again folded inwards, so as to divide it into four parts; and these were again subdivided, by folding them the contrary way, so as to form them into eight columns; in short, exactly in the same manner as in the former instance; and they were also numbered, paged, and indexed in a similar way. Four of these prepared papers, each containing a surface of four and a half inches wide, and twenty-eight inches in length, including both sides of it, could be carried in the exceedingly small space above-mentioned; besides enclosing also the silver pencil and pen-holder.

*The parchment envelop* had its sides made to wrap over each other about half an inch, and they were cemented together by means of *Ratley's excellent cement* (the composition of which we have repeatedly given in our work) which never gave way all the time the envelop was in use; and the whole was kept from bending in carriage, by means of the pen and pencil-holder being enclosed within the writing paper; and which indeed was wrapped around the metal tube, forming the receptacle and handle of these instruments.

*The pen and pencil-holder* was a thin gilt brass tube, three inches and an eighth long, and three-tenths of an inch in diameter; three equi-distant narrow slits being sawn lengthways at each end of it, three-tenths of an inch in length, in order to give those ends a sufficient degree of elasticity, to cause them to hold or retain within them, two ivory pieces, the one being an inch in length, and each end of it turned into a short cylinder, to fit the bore of the tube, its middle being a little larger in diameter, the spaces between them being turned away, or lessened in diameter, so that one end and the middle part only of each ivory piece fitted the tube at the same time, the middle part being firmly held in its springing part, and thus

giving a steady fixture or hold to them in use. Into a hole in the centre of this ivory piece, a silver wire, of the sixteenth part of an inch in diameter, was firmly driven, and which projected half an inch beyond the end of the ivory, and its point being rounded, it thus formed a silver style or pencil, fit for writing upon asses-skin tablets, when they had been previously freed from all the greasiness upon their surfaces, by first wiping or rubbing them over with the end of a soft linen napkin, wetted with a little soap and water; and afterwards, with the same napkin, wetted with water only, to remove all remains of the soap. In this mode of preparation, the asses-skin tablets were rendered capable of readily receiving the marks made by the silver style; and which was of great importance, they would remain indelible until they were obliterated by a similar application of the soap and water.

The other ivory piece was shaped exactly like the one already described, only that it had a cylinder of ivory formed at one end of it, half an inch long, and two-tenths of an inch in diameter, upon which a thin gilt brass ferril could be slipped; which was made of another piece of tube, a little less in diameter than the formerly described one, half an inch in length, and one end of it sloped away at an angle of forty-five degrees, the shorter part of the tube being also slit open lengthways with a saw, so that this ferril also became capable of springing more or less, and tightly embracing the portable pen, which was thus held firmly between it and the ivory cylinder above-mentioned. Of course the pen and silver style or pencil were inverted, or placed within the cylindrical tube when not in use; and a farther supply of three or four more portable pens, when formed as they commonly are, of narrow pieces of quill, could also be carried within the brass tube.

In plate III. fig. 20, *a a* represent the tube; *b* the ivory piece placed in the end of the tube, with the silver style *c* affixed into it; and *d*, fig. 21, the other ivory piece, represented as taken out of the tube, and having upon its cylin-

dical stem *e*, the portable pen *f*, affixed by means of the cleft and springing ferril *g*. This cheap, simple, and effectual pen and silver pencil holder, is well deserving of being brought into common use.

*Additional particulars of Mr. Mylne's parchment-case, or envelop, to contain writing-paper.*—It having been suggested to us that the description we have given of this useful envelop would be rendered much more clear by the assistance of figures; we have accordingly added such, in plate III. of our present number.

Fig. 22 is an inner view of the envelop, and fig. 23 an outside view of it; *h h h h* are the four diagonally creased turned-in ends, which serve to keep the papers contained within the envelop asunder, and to divide the pocket into three, as described in page 118. The dotted diagonal lines in fig. 23 exhibit their appearance sideways; *i* is the rounded flap of the envelop.

*On various contrivances to enable persons to write in the dark.*—One of the most simple of these contrivances was that adopted by a scientific native of Sweden, and communicated to the Editor by a friend many years since.

The object of this and most other contrivances for this purpose, is, to prevent our writing over, and thereby obliterating, what we have already written; and for the accomplishing of this object, the person above alluded to, folded writing-paper backwards and forwards in the way we have above described, only that the folds were much narrower, indeed only sufficiently broad to permit of receiving a single line of writing upon the face of each narrow column so formed. In plate III. fig. 24 represents the end of a piece of writing-paper so prepared; and in using it, the first line of writing is to be done upon the uppermost column, which is then to be turned up out of the way, and the next line written upon the column *k*, and so on to the bottom one; all those underneath the writing being gathered close to each other at the time. When all these columns have thus been covered with lines of writing, the paper is to be

inverted, and the intermediate columns, *o*, *p*, *q*, *r*, &c., are, in their turn, to be likewise written upon; by this proceeding, one side of the paper will be closely covered all over with lines of writing, every other line being inverted, so that there is no possibility of their being confounded with each other. In like manner the opposite side of the paper is also to be covered with writing in its turn; and thus it will have received much more writing upon it than without this contrivance it would have been possible to effect, unless indeed by rendering the lines of writing liable to become mingled and confounded with each other.

*On a French night-writer.*—This ingenious contrivance consists of a flat case, made of paste-board, and covered with Morocco leather, in the usual manner of the pocket-book makers, three inches and three-quarters of an inch in width, and six inches long; and having along one side of it a space to contain a black-lead pencil, as shown at *s*, in figs. 25 and 26 of plate III., the remainder of it being filled with a doubled piece of asses-skin, *t*, fig. 25, which can be withdrawn out of the case by pulling or drawing at one end of a narrow ribband, which is secured to the middle of the inside of one side of the case; and its other end passes through a small slit made in the opposite side of it, in the usual manner of card-cases. In one side of this case four parallel longitudinal openings *u u u u* are made, having between them three solid bars *w w w* of an equal breadth with the openings; and also another solid part *x*, formed upon that side of the case which is opposite to the space for holding the pencil. By this contrivance four lines of writing can be written in the dark within the four openings in the side of the case, upon the asses-skin; and, upon withdrawing it and replacing it again in the case, but previously turning it end for end, or inverting it, four other lines may be written upon the same face of the asses-skin tablet, but in an inverted order, so that they cannot possibly be mistaken for, or confounded with the four lines first written. In like manner eight other lines may be written

upon each of the other three faces of the doubled piece of asses-skin, making thirty-two in the whole; and should it be likely that these might not be sufficient to receive the whole intended to be written, we have only to provide more of the doubled pieces of asses-skin, and thus extend the surfaces to any degree.

Our figure 25 represents the asses-skin as being partly thrown out of the case; it should be pushed entirely within it previously to writing upon it.

We shall give other contrivances for a similar purpose in the progress of this article.

*On preventing the writings made with black-lead pencils, in memorandum books, from being obliterated.*—We are now so well provided with superior black-lead pencils, in those made by Brookman and Langdon, and other persons, and the ever-pointed pencils, that it becomes an important object to prevent the writings made therewith from perishing, or becoming obscured, as they continually do, in consequence of the writing on the one page giving off, and defacing that made upon the opposite one, as well as itself likewise.

We are indebted to the late scientific Mr. John Farey, whose name we have already mentioned in this article, page 116, for a method of obviating this inconvenience, which is, by causing *blotting paper* to be interleaved between the leaves of the writing paper; and the consequence is, that the black-lead is now merely given off to the surfaces of the blotting-paper, and effectually hindered from reaching the writing upon the opposite pages; and in this way, we have found writing performed with a black-lead pencil, to endure for years together in a perfectly legible state, in memorandum books carried continually in the pocket whilst travelling.

*On facile and portable means of procuring fire and light.* We have already stated the preference which ought to be given to the flint and steel, over all other methods of procuring those indispensable requisites, fire and light; and

shall now proceed to describe a variety of portable apparatus adapted to their employment.

In plate III. fig. 27, *y y* represents a thin silver tube, open at both ends; and *x* the loop of a silver wire hook, shown separately in fig. 28; both these are shown of their full size, so that no objection can possibly be made on the score of their portability. The material to be ignited by the flint and steel, is a plaited cotton match-cord, shown in fig. 27, as being wrapped around the silver tube, with the silver hook passed through it, and its upper end ready to be applied upon a flint, near to the edge of it, so as to receive the strokes from the steel, in order to ignite it. This match-cord is made of four loosely spun cotton threads twisted together, and four of these twisted threads afterwards plaited in the manner of a whip-lash. This combined cord is then steeped in a solution of nitre, and dried, which fits it for igniting in the manner of the German tinder, by the sparks produced by striking the steel upon the edge of the flint. Great care ought however to be taken, that the nitre be purified from all remains of the *mariate of potash*, which is apt to render it deliquescent, and prevent the match from catching fire; and indeed this is a chief defect in most of the German tinder sold at the stuff shops in town. Although fig. 28 represents the match-cord as being entirely drawn out of the tube, yet, in fact, it ought only to be drawn out far enough for use; and when it has been ignited, and has kindled the sulphured match, it should be pulled back again into the tube, until the loop of the hook rests upon the top of the tube, as shown in fig. 27, when it will be extinguished; and the remainder of it must be wound round the tube in the manner there shown, and as before described.

A very portable sulphured match is formed, by drawing one of the four cotton twisted threads abovementioned, through melted sulphur; and which, after it has been kindled by the ignited match-cord, may be extinguished, and thus be made to serve many times repeatedly; and in-

deed, until it is all burnt out. This kind of sulphured cord is preferred to every other sort of match upon the continent, and ought to be more frequently employed here.

A *steel* may be readily found in the back of the blade of a knife, razor, &c. And a *gun or pistol flint* may be had everywhere; so that we never need be without the means of procuring a light.

The cotton twist alluded to is to be had of the haberdashers, it being made for the purposes of the sempstress, and not for lamp-wicks. This intimation is necessary, in order to prevent disappointment in the purchaser.

(To be continued.)

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*On the Compound Eyes of Insects.* By THOMAS CARPENTER, Esq.

DEAR SIR,

London, February 7, 1829.

HAVING been applied to by some of your readers, to point out to them such insects as possess the most interesting compound eyes, as objects for their microscopic examination, and to inform them of the method I took to prepare them for that purpose; and also, whether I had entirely satisfied myself that these little creatures, so apparently insignificant, did really possess such amazing numbers of eyes, as are described by me in your second volume, page 198. I beg leave to answer these questions through the medium of your Repository.

I consider that there is no insect whatever, whose eyes are not highly interesting objects; the exquisite contrivance displayed in the construction of these delicate organs astonishes us, in the display of the Almighty Power, evidently manifested in adapting means to an end. The eyes of insects, though they differ considerably in their construction from those of other creatures, are yet no less the objects of our admiration. Indeed, amongst the exterior parts of insects, none are now worthy of minute investi-

gation ; and very few persons are to be found, who can be insensible to the beauties of these organs, when exhibited under the microscope ; as that instrument alone points out to us the prodigious art employed in their organization, and evidently shows how many wonders escape the unassisted sight. The eyes of the libellula for instance, which are a couple of protuberances immoveably fixed in the head of the insect, are, on account of their size, peculiarly well adapted for examination under the microscope ; and, by the assistance of this instrument, you will find they are divided into a number of hexagonal cells, each of which contains a complete eye. The external parts of these eyes are so perfectly smooth, and so well polished, that when viewed as opaque objects, they will, like so many mirrors, reflect the images of all surrounding objects ; each of these protuberances, in its natural state, is a body cut into a number of facets, like an artificial multiplying glass, but with this superiority in the workmanship, that as in that glass every face is plane ; here, every one is convex ; they are also much more numerous, and are contained in a much smaller space. If one of these protuberances, carefully removed from the head of the insect, be washed clean, and then placed under the microscope, its structure is distinctly seen, and it becomes an object worthy of the highest admiration.

You will find that each of the eyes is an hexagon, varying in its size according to its situation in the head ; and that each of them is a distinct convex lens, and has a similar effect in forming the image of an object placed before it ; of this you will be convinced, by turning the reflecting or illuminating mirror of the microscope, so, as to bring the picture of the flame of a lamp or candle within the compound eyes, and you will have a beautiful and resplendant blaze, produced from multitudes of images of regular flames, one being formed in each separate eye. Other creatures are obliged to turn their eyes towards the object, but insects have eyes directed thereto, on whatever

side it may appear. They more than realize the wonderful accounts of fabulous history. Poets gave to Argus an hundred eyes, now insects are furnished with thousands, and have the benefit of vision on every side, with the utmost ease and rapidity; although without requiring any motion of the eye, or flexion of the neck. I have often been asked what reason I could assign, for organs so complicated and numerous being given to insects; and I have uniformly replied, that I could not answer that question, unless it was, that their Creator and our's had so willed it, in order to show his Almighty Power in the perfection of his works!

The method I took in preparing the eyes of insects as microscopic objects was simply as follow:—Wishing to procure a series of these objects for my microscope, and as many persons had expressed a disbelief in flies and other insects having such numerous eyes, as had been previously stated by authors of deep research into the minutiae of nature; and also in order to satisfy myself whether they really did possess those astonishing numbers, and that they were all separate eyes, each eye possessing the sense of seeing, I selected out from an old collection various flies, beetles, and aquatic insects, and placed them in water for several days, in order to relax and soften the parts intended for dissection. (I made choice of these old specimens, because I have a repugnance to any act of cruelty in operating upon living subjects, let their scale in the creation be ever so low.) When these insects were in a proper state for my purpose, I proceeded to dissect their eyes, in the most careful manner, to the amount of upwards of two hundred: amongst which were the following kinds, viz. Various species of the boat-fly, dragon-fly, cicada, ephemera, dyticus, cimex, nepa, curculio, ant, gnat, bee, wasp, musca, ichneumon, millipedes, dynastes, silpha, bombardier, inquisitor, cock-chafer, staphilinus, peach-fly, cicindela, ear-wig, buprestis, cerambyx, panorpa, grasshopper, locust, cricket, mantis, cock-roach, domestic black-beetle,

tabanus, stomoxys, moth, butterfly, lobster, and cray-fish. When this task, which required both patience and perseverance was accomplished, I had the gratification of being fully convinced, that however wonderful it might appear, the whole of these insects did really possess numerous and distinct eyes, varying in number, according to the species of insect; in some I have counted upwards of forty, in others a thousand, and so on in progression, until I have even met with upwards of thirty thousand in some species! And had those certainly eminent men of science, who, in order to support a mere theory of their own, have asserted that they were not eyes, examined for themselves experimentally, as I have done, I am certain that they would agree in my conviction, that they really were distinct eyes. An eminent philosopher, whose writings I hold in much esteem, asserts, that some insects are without these reticulated eyes; and that even in those insects which have them, he does not consider them to be the organs of vision. I do not know the insects he alludes to, as not having the reticulated eyes, but if they are of the genus dynastes, I have examined many species of that genus, and find that the reticulations are indeed very minute, but are more numerous than in many others. He also states, that there is nothing in them analogous to a retina. I would ask him, what are those divisions under the layer of tubes, which are uniformly found under the corneas of their eyes? I consider that part to be the retina. He also says, that he considers the *stemmata* of insects to be their only eyes. Now, as many species of insects have *no stemmata*, I would ask him, in that case, where are *their eyes*? The answer is plain,—those reticulated organs must be the eyes, or if not the eyes, what are they? He further asserts, that the internal surface of the cornea of the lobster is only divided into squares, by a cancellated texture adhering to its under surface, which is clearly a mistake, as the cornea is divided into various lamina or plates; and if the under plate is taken away, with what he terms the cancellated texture, it

will be seen that the plate is also equally divided, and that in every other plate are also the same number of squares or divisions.

Another very scientific gentleman describes the eye of the *gryllus gryllo-talpa*, or mole-cricket, as having a cornea, with a dark pulpy matter underneath it, which would prevent vision. Now, had he examined this dark pulpy matter before he had destroyed its figure, he would have seen that it was composed of a series of distinct tubes, each being fitted to a lens, composing one of the numerous lenses with which the cornea of that insect was studded; and, with a good microscope, he would have discovered all the parts which I shall now proceed to describe in the eyes of the various insects I have dissected. It is not my wish to detract in the least from the great abilities of these gentlemen, whose scientific attainments do them great credit; but I presume they have either rested their authority on the opinion of others, instead of minutely examining for themselves, the wonderful construction and mechanism displayed in the eye of an insect; or else they may have taken a specimen in a dried state, and which would have the appearances described by them; for had they examined a recent specimen, or one that had been soaked in water sufficiently long to have relaxed all the parts, they would have given a very different statement to that they have made.

After I had thus satisfied myself, as above stated, I then cleaned out the cornea of each eye, and placed it between slips of glass; and, when examined under my microscope, I distinctly saw the image of the lamp-flame, or any other object, in every lens contained in the cornea of each eye. Those of the water species, I usually found more convex and hard than those of the land, and which, I presume, is a wise provision made for them by their Creator, in consequence of their inhabiting a denser medium; and also in the same cornea, viz. that of a boat-beetle, I have found that some of the vessels were in the form of hexagons, and

others of long squares, and varying also in their magnifying power; the square shaped ones showing the image of the lamp-flame full double the size of that image, when seen in those of the hexagonal shape. As your microscopic readers may possibly wish to dissect the eyes of insects, and other creatures, in order to satisfy themselves, as I have done, so I would recommend them first to operate upon the eye of a boiled lobster, or a French cray fish, as the construction of these eyes are similar to those of insects, and they are not so difficult to dissect; and to treat it in the following manner:—

Steep or soak the eye in warm water, until it is soft, or saturated with moisture; then remove the cornea, which they will find studded all over with square divisions, each square being a perfect lens, and amounting to upwards of ten thousand, in the corneas of the two eyes. The cornea itself will also be found to be composed of several distinct lamina or plates, lying one over the other, like the coats of an onion, and each plate being studded all over with the same number of minute lenses, so that when the plates are combined, they fit to each other, similar to the several achromatic lenses in the object-glass of a telescope. Under the lower plate in the cornea, and covering it all over, they will discover a fine membrane, full of minute ramifications, or blood-vessels; and under this fine membrane will be found a number of square tubes, exactly corresponding with, and fitting into, each set of lenses in the compound cornea. If these tubes are carefully removed, they will then come to the retina, in which they will find the same number of divisions as are in the cornea, and in each of these divisions a lens, which receives the image of any object, as perfectly as the lenses in the compound cornea itself did—so that each compound lens in the cornea has a tube attached to it, which conveys the image of any object formed on it to the divisions in the retina, or to the sense of seeing in the brain. It therefore does appear that the compound eyes of insects, all of which are constructed in a

similar manner to the above, are, in fact, an assemblage of achromatic telescopes! The various eyes of moths and butterflies, which I dissected, I found to correspond in their construction with the above, being furnished with lenses, tubes, &c. &c. One of the large hawk-moths, as mentioned by me in vol. 2, page 195, had upwards of forty thousand divisions in the two corneas, and which corneas were composed of at least five plates or lamina, each plate being studded with as many lenses,—so that, by multiplying forty thousand by five, it would appear that there are upwards of two hundred thousand lenses in the head of this moth! We are apt to suppose that nature has lavished all her bounty upon her larger creatures, and left her “minims of existence,” as Shakspeare phrases it, unfinished. With what different ideas, however, must those be impressed, who find the apparatus for vision in these small creatures, so various and so wonderful in their structure, far surpassing the mechanism of the eye in the more noble animals, and who must also perceive so much design and order manifested in the position, construction, and number of these delicate and useful organs.

The dissection of a single eye of the lobster, or cray fish, is so easy to be performed, that every inquirer into the minutia of nature should view the various parts of it under his microscope; and it is impossible to describe its beautiful and complicated structure. These organs are so exquisitely finished, that I do not know of any structure in the insect tribe which comes near them; except, indeed, the feet in the first and second legs of the male dytiscus, described in your present volume, page 75; and a fine drawing of which was made by the celebrated Mr. Bauer, and published in Sir Everard Home's *Comparative Anatomy*. I feel no hesitation in saying, that the most confirmed Atheist (if ever there was such a character) on viewing the complex machinery of these minute specks of a wondrous whole, would be constrained to say, “There is a God,” and would from that moment renounce his infidelity. Allow me to

conclude this letter with a few lines from Thomson's Seasons :—

“ Let no presuming inpious railer tax  
Creative Wisdom, as if ought were formed  
In vain, or not for admirable ends.  
Shall little haughty ignorance pronounce  
His works unwise, of which the smallest part  
Exceeds the narrow vision of her mind ?”

“ And lives the man, whose universal eye  
Has swept at once the unbounded scheme of things ;  
Mark'd their dependance so, and firm accord,  
As with unfaltering accent to conclude  
That this availeth nought ? Has any seen  
The mighty chain of beings, lessening down  
From Infinite Perfection, to the brink  
Of dreary Nothing, desolate abyss,  
From which, astonished thought, recoiling, turns ?  
Till then, alone let zealous praise ascend,  
And hymns of holy wonder, to that Pow'r  
Whose wisdom shines as lovely on our minds,  
As on our smiling eyes his servant-sun.”

I am, dear sir,

Your obliged friend,

To T. GILL, Esq.

THOS. CARPENTER.

*Remarks. By the EDITOR.*

We are happy in being enabled to confirm these statements of Mr. T. Carpenter, both from seeing a great number of his preparations, and also from our own experiments upon the compound eyes of the French cray-fish, the lobster, and the common domestic or house-fly. And, indeed, in plate IV. of vol. II. of this work, we have given figures of the preparations made from the eye of the French cray-fish ; and in plate VIII. of the same volume, other figures, representing the division of the square tubes in that eye, as spoken of by Mr. Carpenter, into four parts ; evidently caused by their being open internally, and thus separating themselves in consequence thereof. We have also given, in the latter plate, a figure of “ *the optic nerves of the same animal, as radiating from a white hemi-spherical body, which evidently*

*was part of the brain of the animal."* And we have also found great numbers of similar tubes in the black mass taken out of the eye of the common domestic or house-fly, although of a much smaller size than those of the cray-fish.

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**XXIII.—*On the Irrigation and Culture of the Val de Chiana, in Tuscany* \*.**

"BEFORE Arezzo we cross the river Chiana, anciently named Clonis, which runs into the Arno; another part of the waters of the same valley of the Chiana goes into the Tiber.

"The Val di Chiana is forty miles long, and from seven to twelve broad, laid out into cultivated fields, divided into regular inclosures and squares, with ditches round every ten or twelve acres, and maples and elms, supporting vines, on the banks of the ditches.

"It was converted into arable ground, from the state of a marsh, by Cosimo I. in 1560, soon after he got possession of the territory of Siena, in which territory half of the valley of the Val di Chiana is included. The Chiana, in its whole length, was first confined between embankments, and then the streams that run into it were confined in a similar way.

"Cassini and Viviani were employed, the former by the Pope, the latter by the Grand Duke of Tuscany, to regulate the distribution of the waters of this valley.

"The Val di Chiana is interspersed with considerable farm-houses, like gentlemen's seats, with extensive offices. Many of these are the property of the Grand Duke, to whom a great part of the valley belongs, and were built by the Grand Duke Leopold, who also constructed roads, bridges, embankments, and drains in the Val di Chiana,

\* From "A Journey through Carniola, Italy, and France," by W. A. Castell, Esq. F. R. S. of Lond. and Ed.

and in the Maremma of Siena, which has thereby become less unhealthy; and for these beneficial works, and for the good regulations he made, his memory is honoured in Tuscany. The Grand Duke Leopold succeeded his brother, Joseph II., on the imperial throne, in 1790.

“Although the ground is lower than the waters in the rivers, yet the Val di Chiana is said not to be unhealthy. The countrymen never go out in the morning without eating bread, and drinking some wine. They look stout and healthy. The Val d’Arno di Sopra is considered to be equal in fertility to the Val di Chiana.

“In the Val di Chiana, fields that are too low, are raised and fertilized by the process called *colmata*, which is done in the following manner:—The field is surrounded by an embankment to confine the water. The dike of the rivulet is broken down so as to admit the muddy water of the high floods. The Chiana itself is too powerful a body of water to be used for this purpose; it is only the streams that flow into the Chiana that are used. This water is allowed to settle and deposit its mud on the field. The water is then let off into the river at the lower end of the field, by a discharging course, called *scolo*, and in French *canal d’ecoulment*. The water-course which conducts the water from a river, either to a field for irrigation, or to a mill, is called *gora*. In this manner a field will be raised five and a half, and sometimes seven and a half feet in ten years. If the dike is broken down to the bottom, the field will be raised the same height in seven years, but then in this case gravel is also carried in along with the mud. In a field of twenty-five acres, which had been six years under the process of *colmata*, in which the dike was broken down to within three feet of the bottom, the process was seen to be so advanced, that only one year was requisite for its completion. The floods in this instance had been much charged with soil. The water which comes off cultivated land completes the process sooner than that which comes

off hill and wood-lands. Almost the whole of the Val di Chiana has been raised by the process of colmata.

"A proprietor, whose field is not adjacent to a stream, may conduct the stream through the intervening lands of another proprietor, on paying for the damage he occasions. The process of colmata is expensive, because the ground is unproductive during the seven or eight years that the process lasts; but this is soon repaid with great profit, by the fertility of the newly deposited soil.

"By the gravel which the rivers carry and deposit, their bed is much raised above the level of the adjoining fields; so that, in order to carry off the rain-water from the fields, drains are formed, which pass in arched conduits under the embanked rivers, and go into larger drains, which pass to the lowest part of the plain near Arezzo, and there enter the Chiana.

"The soil in the Val di Chiana is generally the same to the depth of six feet from the surface, and under that is gravel or sand. After the completion of the process of colmata, the expense of which is always repaid with profit, the ground is cultivated for five years on the proprietor's own account; and the produce during these five years repays the expense of the process of colmata with interest. The two first years it is sown with Indian corn (*gran turco*) and sometimes hemp, the soil being too strong for wheat. The next three it is sown with wheat, without any manure. The produce of wheat, in this highly fertile state of the soil, is twenty from one; whilst, in the usual state of the ground, the return of wheat is from twelve to fourteen after one. After this, the field is let out in the ordinary way to the farmers, the *contadini*.

"An operation similar to the colmata has been practised near Gainsborough.

"In different parts of Britain we see as heavy crops as can stand on the ground; but they have in Tuscany a greater variety of produce, and can follow a more speedy

rotation of productive crops, advantages which are owing to the warmth and fine weather of the climate. Tuscany is 120 English miles in length, on a meridian line from north to south, and 100 miles in breadth from east to west; but a great part of its surface is mountainous, and not susceptible of cultivation.

"The farmers in the Val di Chiana, and in other parts of Tuscany, are steel-bow tenants, *coloni partiarii*, the whole produce of the ground being divided into two equal parts, of which the landlord gets one, and the farmer the other. The landlord is at the expence of the manure, the repair of walls and other fences, reeds and stakes for vines, agricultural implements, and live stock of oxen, &c. land tax, and of keeping a steward, or *fattore*, who collects and sells the landlord's share of the produce, and of houses, granaries, and stables for the farmer and stock. The farmer on his part cultivates the ground and performs all the requisite labour; he also bears half the expence of seed and some other articles:

"In this mode of farming land, as in other cases where the rents are paid in grain, the value of the rent keeps pace with the price of the grain. The landlord is put to the expence of keeping a steward to sell the produce, which expence he does not incur in the case of a fixed rent. Writers on political economy are of opinion, that this mode of letting ground occurs chiefly in countries where the farmers are not possessed of sufficient capital to purchase the stock necessary for the farm; and maintain that it tends more to the improvement of agriculture, when the farmers are possessed of capital, and pay a stated rent.

"In Scotland it used to be estimated, that the rent paid to the landlord, generally amounts to one-third of the total produce of the farm. Of the other two-thirds, one is employed in defraying the expence of stock and cultivation, and the other is the profit of the farmer. If it be supposed, that in Tuscany the landlord's expence on the farm is 16 per cent., or between a sixth and a seventh of his half share

of the produce; then his profit or clear rent will be in this proportion of one-third of the produce.

"Land near Siena sells at twenty year's purchase of the nett annual profit or clear rent.

"The mode of dividing the produce of the soil between landlord and farmer was in use in Italy in the time of the ancient Romans.

"The system of the ancients, however, differed in respect to the slaves, whether saleable separately, or attached to the land, *gleba adscripti*, who were employed in its cultivation. The ancient Romans had also lands let at fixed rent, as had the Italians of the middle ages, who employed to denote this rent, the word *fitto*, from the Latin *fixus*, *census fixus*, written in the middle ages *census fectus*; and from this the modern Italian word *affitare*, to let.

"*Medietarius*, in the middle ages, was used in the same sense as *partiarus*, and from *mediatarius* is formed the French word *métayer*, which originally signified a steel-bow tenant, but is now applied to farmers of every kind, in whatever way their rent is allotted, and *metayrie* is a farm generally.

"The oxen used in the plough in Tuscany are very tractable, but slow. In the Val di Chiana, one pair, drove by one man, ploughs an acre a day. This is done in eight hours, and the man works four more in other labours of the farm. The ground when prepared for seed is as fine as garden mould.

"The oxen in Tuscany are beautiful, large, and of a grey colour, with fine deep chests and little bone; and, when fat for the butcher, at four years old, weigh seventy-five stone English, and sell for a price equal to twenty guineas.

"At a great fair for the sale of cattle at Cortona, an astonishing number were seen, beautiful, and in good condition. They have abundance of green food all the year.

"Beef and mutton are sold in the market at Siena, at four-pence sterling, for a quantity equal to an avoirdupoise

pound. Pork, *magale*, is good, and fed entirely in the woods, on acorns and some chesnuts. Wild boar, *cignale*, is plenty and good in the market at Siena, and is sold at five-pence sterling, for an avoirdupoise pound.

“Wheat is sown much thinner than in Britain, on broad drills, and the seed is covered in with hand-hoes. They sow wheat in the end of October, and beginning of November, and reap in the beginning of July. The wheat is well filled, clear, and hard. The farms are so small, that they cut down the corn with the labourers usually employed; or, at least, have only occasion to hire one or two additional ones.”

“The country people, the *contadini*, cut down the crop usually in six days, and during that time they work very hard under the bright and elevated sun in July, from four in the morning, till eight or nine in the evening, with only two hours of rest in the day. Most of the country people are small farmers, few of them are labourers only. The wages in the country are nine-pence, in Siena ten-pence, a day.”

“After reaping, the corn is immediately thrashed out, and laid up in the granaries, which form part of the farm-houses.”

“Near Siena they sow wheat every second year. The usual return of wheat is, as before said, twelve to fourteen after one; but when wheat is taken two years successively, the second crop is somewhat less productive than the first.”

“The usual course of husbandry, in the Val di Chiana, is, two years wheat, with a little manure each year. Then, after the second year's wheat is reaped, the land is ploughed and turnips are sown; the turnips are off the ground by April. Then the land is *dug*, manured, and planted with Indian corn, beans, hemp; or, if the land is not manured, it is sown with kidney-beans, lupines, a kind of clover, vetches mixed with oats, *lupinelli*; the three last are all

for the cattle; the lupines, after they have grown for some time, are generally ploughed in as manure."

"The crop of turnips is great, and the turnips are of a large size. The profit from Indian corn and hemp is greater than from wheat, but they both require more manure, and the land must be *dug* for them. The produce in wine is considerable, but the wine is of an inferior quality in most parts of Tuscany. Vines are trained on espaliers, in rows, thirty or forty yards from each other; and corn is cultivated on the ground between them."

"The *Monte Pulciano* the most esteemed wine in Tuscany, is like a weak claret, with little flavour, and does not bear the voyage to England."

"The profit on silk is also considerable. Of an estate in the Val di Chiana, of two thousand five hundred pounds sterling a year, six hundred pounds of the rent was produced from the culture of the white mulberry trees, called *gelsi*, and the rearing of silk-worms.

"In many parts of Italy, the proprietors of the white mulberry trees, which are planted as hedge-rows in the cultivated fields, do not rear silk-worms; but send the leaves to market, to supply those who have silk-worms.

"All the fallow crops are well hoed. The wheat is sown in broad drills, and they often hoe between the drills. The wheat, when grown, is generally so strong, as to leave no visible marks of the drills, and is higher than a man's height.

"*Note.*—The above remarks, on the agriculture of the Val di Chiana, and of Tuscany, are collected from the notes of a gentleman, well acquainted with British agriculture, who lately passed a year in that part of Italy."

XXIV.—*On Working Cast-Steel, so as to preserve and even improve its good Quality.* By the EDITOR.

THE Editor lately conversing with Mr. Scipio Olin, a medal die engraver of considerable talent, he stated, that a circumstance had occurred to him, which he was totally unable to account for; he had a graver, of a very superior quality, indeed the best he ever used; but, suddenly, he found it become quite soft, and entirely useless to him. The Editor explained the circumstance to him, by stating, that the tool had been only hardened for a part of its length, and that the excellent quality of it arose from his using that portion of it which immediately adjoined to the soft part, and where, consequently, it had only received the proper degree of heat to preserve the steel in its best state. That the soft part immediately adjoined to the hard part, and, in fact, was as soft as the steel was capable of being rendered; so that, on grinding or whetting his tool, to renew its edge, he had at length got through the hardened part, and had suddenly entered into the soft part of it.

This circumstance deserves to be more attended to than is generally supposed, and we can always command that part of the steel, which is of the best quality, by carefully heating the point of the tool, and quenching it in water; we then with a file, try which part of it is hard, and which soft, and choose that portion of it which most nearly adjoins to the soft part to form our cutting point or edge of.

If, besides, we previously heat the steel to a degree just short of the hardening point, and quench it in water, we shall find that it is quite soft, and is capable of spreading or yeilding under the hammer, and we can then close its pores, and condense it in the most effectual manner. We must then, as above-mentioned, again carefully heat, and quench it in water, and form it into our tool; and, provided the steel be of good quality, we shall thus have availed ourselves of every circumstance necessary to ensure its perfection. It is surely well worth while, for every one,

wishing to possess excellent tools, to avail themselves of these instructions, and which a very little practice will enable them to do ;

If steel be overheated, as is most generally the case, in the ordinary methods of working it, it is quite impossible to obtain a good result ; and therefore in proving every fresh bar of cast-steel, we should always ascertain the proper or least heat at which it will harden ; and endeavour, as much as possible, in forging it, not to exceed that degree of heat ; and we shall then preserve the good qualities of the steel in the highest degree. And although it will certainly require more labour to work it, at a lower heat than usual ; yet when we wish to procure excellent tools, it is worth while to bestow that extra labour upon it.

The following is a case which lately occurred to the Editor, and will serve to elucidate the above remarks. He found a young man labouring to drill holes through thick iron wheel-tire, but he made such slow progress, that he thought his drill must have been improperly shaped, and, accordingly suggested an improvement in its form ; still, however, the desired end was not obtained ; and, accordingly, he advised him to forge it anew. On proceeding to do this, he heated it, as usual, to a white heat, which the Editor told him must certainly greatly injure its quality ; and, indeed, it proved so in the event. On this, he desired him to cut off the burnt part of the drill, and endeavour to find out the lowest degree of heat at which the steel would harden ; he did so, and then worked it into form at that heat, and proceeded, under the Editor's instructions, to make a drill, with the proper degree of care. When the drill was finished, he found that he could perforate the iron-tire in a much less time, and more easily, than he ever before could accomplish ; and promised, that, in future, he would carefully attend to the lesson he had thus received, on working cast-steel to the best advantage.

In our *Technical Repository* we have given numerous

articles on the proper methods of working cast-steel, to which we must refer those of our readers who feel interested on the subject. What we here state, however, contains the essential particulars necessary to be observed in order to obtain good tools; and we know of several excellent workmen who carefully work their steel according to them; and particularly in making dividing-knives, for cutting the divisions on the limbs of astronomical and other instruments, and which require to have an exceedingly thin and perfect edge, in order to cut the divisions fine and deep.

These tools may possibly require to be tempered after hardening them, as usual; if, however, they will stand without tempering, which, in many cases may be the case, so much the better. The steel will be found to be much denser when worked in the manner here recommended than when it has been overheated, as is too commonly the case in the ordinary methods of working it.

If the tools require to be made of a good quality for a considerable length, then we must endeavour to heat them *uniformly* to the proper degree, before quenching them to harden them. This may be accomplished, if, instead of heating them in the forge fire, we employ an iron tube, closed at one end, such as a piece of a gun-barrel, or of a gas-pipe, and place it in the forge fire; and especially if we also make what is termed "a hollow fire" over it, which will tend to preserve the tube at a more uniform heat. We can thus heat the tool in the tube for a considerable length, to an uniform degree, and thus procure tools whose good qualities will endure for a considerable period, provided that we carefully ascertain the proper hardening heat of the cast-steel, and endeavour to keep the tube at that degree. The tube has also the good effect of preserving the steel heated in it from coming in contact with the *pit-coal*, of which the fires of forges are commonly made, and whose quality is very frequently of a most prejudicial nature. It would be much better to make the fires

of charcoal, as indeed is practised by some excellent workmen.

It is well to observe, that the entire of every bar of cast-steel, will, in general, be found to be of the same quality; and, therefore, that one trial, to ascertain its proper hardening and working heat, will be sufficient for all the articles to be formed out of that bar. And, indeed, that all the bars drawn out of one ingot of cast-steel would also be of an uniform quality, provided that due care had been taken in the drawing them out not to overheat them. As, however, it must unavoidably happen, that the bars drawn out of various ingots must be mixed together, before they can be brought into a state for sale; so it becomes necessary to try every individual bar, in order to ascertain its true hardening heat.

The quality of various articles made of cast-steel may also be greatly improved, even after being hardened and tempered; such as saws, trowels, scythes, hay-knives, and other thin articles, provided they will admit of being heated to the *spring-temper*, or of being *blazed off*, as it is termed; as at that heat the steel is capable of yielding to the blows of a hammer, and thus becoming very considerably denser, than as left from the hardening. In this way Mr. George Walby improved the quality of his long celebrated bricklayer's and other trowels, by dexterously giving them a rapid succession of blows with a hammer, when laid upon an anvil; and thus, at the same time that he removed the warpings occasioned in them by the hardening process, he greatly increased their density, and consequent durability.

Some cast-steel articles are even susceptible of being condensed, and their quality consequently improved, after being hardened and tempered, without being heated at all. In this way, as we have formerly stated\*, Mr. Edmund

\* In vol. VIII. page 296 of the *Technical Repository*.

Turrell, our engraver, has improved the gravers commonly sold at the tool-shops, to that degree, as to render them capable of cutting the steel-plates, now so frequently substituted for copper-plates. This he effects by placing the back of the graver upon an anvil, and striking upon its edge with the pane of a watch-maker's hammer, a number of light blows in succession, and which he finds will have the effect of blunting its edge to a certain degree, but that afterwards he can no longer produce any impression upon it; and indeed this period is ascertained by the sharp ringing sound produced by the blows, when the steel has received their condensing effect. He then again grinds and renews his edge out of this hard part of the graver, with the good effect above mentioned, of its being rendered as capable of cutting steel as copper.

The teeth of narrow saws may be also condensed by hammering upon the tops of them in the manner above described, and which has likewise the good effect of *thickening* or spreading them sideways, and thus enabling the saw to work more freely, after the teeth have been again sharpened, by filing them as usual; but with care, nevertheless, not to remove or file away their condensed points or tops. The saws will thus not only be fresh sharpened; but will also cut much harder metals than they were capable of doing before being thus treated.

The thin points of small drills, are also susceptible of being condensed by hammering their flat sides, after being hardened and tempered; as was found by Mr. Andrew Pritchard, who upon our suggestion, adopted it with considerable advantage; as we stated in the eighth volume of our *Technical Repository*, page 362; and the drills were thus rendered fit for perforating metals, which they were quite incapable of acting upon in their merely hardened and tempered state.

Many of our readers must, no doubt, have witnessed the effect of the softening action occasioned by quenching cast-steel at a heat just below the hardening heat, by

finding the stems of their small drills to become twisted in use, close to their hardened points. And therefore if, in renewing their points as usual, by heating them in the flame of a candle, they carefully observe to quench their points in water, at a heat just below the proper hardening heat, they will find them to yield or spread under the hammer most readily.

In confirmation of our above recommendation of employing charcoal as fuel, in the forge fires used for heating cast-steel in, we may add, that Mr. Fox, the celebrated engineer and lathe manufacturer, of Derby, has long used it, in a small portable forge; and also, that he coats over his steel articles with a thin layer of loam mixed with water, by dipping them into the mixture, and which he dries upon them previously to putting them into the fire, in order to avoid oxidizing or scaling them; and that the loam instantly flies off the articles on dipping them into water to harden them, so as not to impede that operation in the least degree. That scientific citizen of the United States, Mr. Lukins, whose communications have frequently formed a part of our *Technical Repository*, as well also of the *Technological Repository*, also employs loam for a similar purpose.

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XXV.—*On Glass-Working in Miniature. By the late celebrated ABBE NOLLET.\**

WITH FIGURES.

WE have in the "*Technical Repository*," described Tilley's portable Hydro-pneumatic apparatus, for the use of glass-workers in miniature, as also Cuthbert's valuable combination of it with the pneumatic-trough; we have likewise published, in the same work, Reveley's improved lamp for glass-workers, jewellers, &c.; and in vol. II. of the "*Tech-*

\* From his work, "*L'Art des Experiences.*"

*neological Repository*," we have given both figures and a description of a French glass-workers' and enamellers' table, with its bellows and lamps. To these copious selections we now add the Abbé Nollet's useful instructions on working glass in miniature.

"The table should have a ledge or border around it, of three or four lines in height, in order to prevent the tubes of glass from rolling or falling off; and it should have a drawer underneath it, on the right-hand side, with divisions formed in it to contain the tools used by the enameller or glass-worker; these consist of two spring-tongs, or forceps, the one with flat and rounded ends, and the other with sharp points to it; their other ends, beyond the springing parts, being made thin and flat. Two or three sliding-tongs, of different sizes, with flat rings to them, which serve to close their jaws, in the manner of port-crayons, so as to hold thin iron wires firmly between them. A pair of common scissars, to cut and trim the wick of the lamp. Several gun-flints, to cut glass with. A three-square file, cut rather fine; &c. The drawer may also contain spare cotton wick-yarn, to renew the wick of the lamp. Tubes of glass, of various sizes and thicknesses; rods of enamel, of different colours, &c. &c.

"When all is thus prepared, you proceed to set fire to the lamp which is to melt the glass. In order to this, you take a skein of loosely spun cotton thread, which should neither be too coarse nor too fine; you take as much of this cotton thread, as will form a wick of about an inch in diameter, and four or five inches long, which you place in the front end of the lamp, so that it may rise a little above its edge or border, the remainder of it lying in the body of the lamp, and which you fill either with olive oil, or the fat of horses\*. You then light the lamp, and after it has burned a short time, before employing the bellows, you

\* Hog's lard is found to be excellent for this use; or cocoa-nut oil, mixed with mutton suet. EDITOR.

trim the wick properly with the scissors, so as to cause it to yield a proper flame, neither too great nor too small ; you then bring it near to the nozzle of the tube or blow-pipe, leading from the bellows ; and, with the points of the scissors, you divide the wick into two parts, so as to leave a passage for the wind through the middle of the flame ; you then seat yourself at a proper height before the table, and work the bellows by applying your foot upon the treadle which actuates them, and the flame of the lamp will become elongated in an oblique and ascending direction ; the flame is ordinarily the most vehement at the distance of about two inches from the wick, and it is there that you must present the piece of glass tube to it, that you would soften in its heat, at the same time continually turning it slowly round, to heat it equally.

The double bellows are loaded with a weight placed upon them ; not too great, however, as then it would dissipate the flame in smoke ; nor yet too light, as in that case it would not give it sufficient activity : a little practice and attention will soon enable any one to judge when it is proper. Unless the glass tube to be heated be thin, it must not be placed at once in the hottest part of the flame ; but must be carried nearer to the point of the flame, and be repeatedly placed in it and again withdrawn ; until, after a number of repetitions of these immersions, it may at length be plunged and held within that part of the flame, where the heat is the greatest. In order that the tube you are heating may not crack, or shiver, in case of its being moist inside, you must hold it awhile above the flame ; and above all, if it be thick, you must avoid blowing into it with the mouth, whilst it is open at both ends ; on account of the humidity, which the breath would then convey into it ; this does not happen, when the opposite end of the tube is previously closed, because the breath can only force before it the dry air contained in the tube. When therefore you would extend the glass by blowing into it, you must always previously close up or seal one

send of it; and not only for the reason above assigned, but likewise, because the breath might escape, without swelling out the tube.

In order to seal or close the end of a glass tube, we must soften the edges all around the border of it, and close them, until they will unite and melt together, if the tube be narrow in its bore, as in the case of a barometer tube; if, however, the glass be slender, we need not touch the end of it at all, but merely turn it slowly round for a few moments within the flame, and it will close of itself. But if the orifice is wider, and the glass be thin, we must hold it in the flame with one hand; and, with the ends of the pincers, whilst held in the other, bring together the edges of the glass as they become softened by the heat, and finally close them. But in whatever manner you close them, you must not leave too great a mass of glass at the sealed end, lest it should break in cooling; and therefore, in order to avoid this accident, it is better to remove the superfluity. Thus in order to seal the tube *A*, shown in fig. 29, of plate III. we also heat in the flame another piece of tube *B*, and apply it when melted, by pressing it against the heated end of the tube *A*; we then gently draw out the end of the latter tube, and form the contraction in it, shown at *c*; after which, the action of the flame itself will close up, and cut off the tube, which thus remains thinned and sealed. The superfluous part remaining attached to the end of the other tube *b*.

We should never twist the one way or the other, the piece of glass tube which we hold in the flame; but carefully heat and turn it uniformly; and when we have taken hold of it with both hands, we must turn it with them both equally, or else we shall certainly twist and break it off when it has become softened by the heat. If we would draw out the tube, so as to render it more slender, we must be careful to heat it only just above redness, to withdraw it from the flame, and to draw it out with an uniform motion; at the

same time applying a little more strength towards the close, than at the commencement, of the operation.

Suppose, for instance, we would make a capillary tube: We take a tube *E F* of five or six inches in length, and two or three lines in diameter, we grasp it by its two ends, and place the middle of it *G* in the flame; at the same time resting both elbows upon the table; we then turn and heat the glass to whiteness; and, removing it from the flame, we withdraw the one hand from the other, accordingly as we would have the tube more or less capillary; and agreeably to the size and thickness of the tube we have employed and to the extension we would give it.

The glass may be sufficiently heated to expand by blowing into it with the mouth, but in order that it may become perfectly rounded, it is necessary, Firstly, that we commence with forming a cavity. Secondly, that the glass be of an equal thickness all round. Thirdly, that it be sufficiently heated. And, Fourthly, that it be blown when removed out of the flame, and with good management. We will take, for an example, the bulb of a small thermometer.

We must select a tube *u*, which may be a foot long, or thereabouts, and of half a line in diameter; and take care that it be perfectly cylindrical; having softened one end of it in the flame, we join the end of another tube *i* to it, which we have also previously softened in the flame, and we press them the one against the other, whilst they continue to soften; we thus swell out the glass, and form it into a small mass *k*, and which we also stretch and hollow inside, by blowing in from time to time at the outer end of the tube; we then detach the tube *i*, by melting and drawing it out thin, and continue to carefully heat the small mass *k*, keeping continually turning it round in the flame; until we perceive that it is become sufficiently hot (and which we judge of by its colour), when we withdraw it from the flame, and blow it, with the eyes continually fixed upon it, lest we extend it to a size greater than we could

which : we must also take great care to hold the tube in a vertical position, whilst blowing the bulb, and also to keep turning it round continually, lest it should bulge out to one side. When we would experiment upon the small tubes here described, before blowing them to their full size, we must previously thicken and form a mass at the end of the tube, and enlarge it a little at a time, by many successive attempts, in order to extend the mass, and render it equally thick on all sides ; before giving it the final blast, which shall bring the bulb to its true size.

We blow, nearly in a similar manner, the thin bulbs which are intended to be broken in experiments with the air-pump or the condenser ; that is, either by rarefying or condensing the air surrounding them ; but, in order to avoid the trouble of thickening the glass at the end of the tube, we choose those tubes which are of the thickness of the little finger. We commence by closing the end of the tube, and we then attach another small piece of tube to it, in order that we may hold it in both hands ; we then heat it in the flame at the distance of half an inch from the sealed end, and draw it out a little, in order to form the elongated contraction L ; we then detach the small piece of tube, and having sufficiently heated the kind of olive thus formed, we strongly blow into it, and thus form it into a very thin bulb ; and by presenting one or other of its sides to the end of the flame for an instant, we can occasion them to become flattened a little, which is better than a perfect sphericity for the purposes they are intended to answer. Before removing the part L from the flame, we draw it out a little to render it capillary, and then break it off, in order afterwards to seal it.

When we have thus prepared a sufficient number of these bulbs, and they have become cold, we take them up in a sort of a clamp, formed of iron wire ; its ends being formed somewhat like a spectacle-frame, and its middle part twisted together, as shown at M ; and we do this in order to avoid heating the air contained in the bulbs, by

holding them in the hands whilst sealing their capillary ends, by plunging them quickly into the flame of the lamp, and thus preventing the heat from reaching the bulbs. It is necessary that the clamp should be made of thin wire, lest it might crush these exceedingly thin bulbs.

We likewise prepare, in a similar manner; only with their necks a little lengthened, the small bulbs *n* which crack with an explosion when thrown upon a fire of lighted charcoal: as these are not much larger than a pea, so we blow them of thermometer tubes; and, before sealing them, we warm the bulbs in the hand, in order to drive the air out of them and place their necks in water, which enters them on their cooling; this water, on becoming rarefied, either by the heat of the burning charcoal, or by sticking the point of the bulb into the tallow of a lighted candle, whilst the bulb is placed near the flame of it, expands, and bursts the bulb with a smart noise.

We can also form glass blow-pipes, similar to that shown at *o*, with a swelling in its middle; these should be made with an assortment of different sized apertures; and we prepare them in the following manner. We soften the end of a tube, and attach another to it, in order to draw it out into a capillary tube, as at *p*. We then form the olive *q*, and cut the glass across with a file, at *p* and *q*; we also seal this last end. We then take it in the left hand, and also grasp the open end in the right hand, and heat the middle part of the tube to whiteness, turning it constantly round at the time; we then bring the open end *p* to the mouth, and blow into it; at the same time also drawing out the other end a little, until we can judge by the eye, that we have given to the swelled part the proper dimension. We must take care, however, not to extend it too much, lest we render the glass too thin.

The funnel *r*, is prepared nearly in a similar manner; but before we form the swelling *s*, we entirely remove the tube *r*, *s*, by cutting it off in the flame: we then heat and seal the end *s*, and blow strongly into the swelled part;

the glass swells out at this part, and we then open it, as shown at *r*; but as the glass is very thin around this border, full of cracks, and therefore, liable to break; so we are obliged to cause the flame to play upon its edge, to thicken and to round it; and we finally finish the border by passing the points of the spring pincers around within it very delicately.

When we would prepare an hydrometer, we make choice of a tube that is perfectly cylindrical, and which may be about a foot long, and its external diameter a line and a half, or a little more, its thickness being but small: we first seal one end of it, and then heat it about three or four inches above the sealed end, and thicken the substance of the tube, in order to blow a bulb there, resembling that shown at *v*, and which may be an inch in diameter, or rather more; after having cut the tube in the flame at *u*, and sealed that end, we heat it and blow another bulb there; but much smaller than the former one, as at *u*; it then only remains to cut the tube across at the required length, and to heat the mouth of it, in order to open it a little with one of the points of the pincers.

We shall find no difficulty in bending a tube, after heating it, and withdrawing it from the flame, if the glass be thick, and its bore narrow, provided that we have taken care to soften it equally for the whole length to be curved; but if it be thin and wide in its bore, it will be apt to become flat at the bend: in order to prevent this evil, we must first seal or close up one end of it, and in proportion as we bend it, we must blow in a little at the open end, in order to extend the flattened parts.

When the tubes are very large, in order to prevent them from flattening whilst bending them, we must previously fill them with sand well dried, and then heat over a fire of kindled charcoal the part which we would bend. In this way glass tubes may be readily bent, which are of the thickness of a finger, but they must be heated slowly, and be afterwards cooled gradually.

In the case where we would unite two tubes end to end, we must close up the end of one of them, as at *x*; and also prepare the two ends which are to be joined, by heating first one, and then the other, and opening their mouths with the pincers in the manner shown at *r*, *y*; we then take one of them in the right hand, and the other in the left, and heat them both at once, and apply the widened ends to each other, pressing them together to unite them thoroughly; we then heat anew this joined part and blow in at the open end *z*, in order to extend the closed and thickened joint, at the same time drawing it out straight a few lines, in order to give it an equal diameter with the rest of the tube.

When you would cut a tube, in order to avoid the trouble of heating and cooling {it slowly, you need only apply the cutting angle of the file to it, at the part intended to be separated, and carrying the cut around the tube, break it off there; or you may heat it, and touch the part with the end of the pincers, wetted with saliva, when it will instantly break.

Glass may be attached to iron, which has been heated to redness; but it will fly or crack off again, if either the glass or the iron be too thick; and we can therefore only affix it upon a slender wire, or a very thin blade of iron, which must be heated at the flame of the lamp; the wire or the blade may be conveniently held in the sliding-tongs above mentioned.

If you would work with an enameller's lamp, to form such small pieces as are generally made in this way, and when you only continue at work with the lamp for a quarter of an hour at a time, I would recommend the employment of a small apparatus, which it is but little trouble to use, and at a slight expence, compared with that of a large fire, and one intended to be of long duration. This apparatus consists of a small lamp, similar to those commonly employed, in its shape, but which is only capable of containing one or two ounces of oil; the receptacle in

which this lamp is placed, has below it a cylindrical tube or stem, of the thickness of a finger, and about two inches in length, which can rise and fall within another tube, five or six inches long, and which produces a sufficient degree of friction, to hold or retain the lamp at any required height. This tube is erected perpendicularly in the middle of a flat and oblong bason, made of tinned-iron plate, with a border all round it. The lamp can thus be held at any height which may be convenient.

“ Instead of the bellows, we here employ an eolipile, made either of glass or metal, to animate the flame of the lamp when the wick is lighted; and below the eolipile we place a small spirit lamp, mounted upon a stand with three feet to it, and which supports a flat circular ring of tinned-iron, having affixed to it two springing branches, terminated with concave ends, which embrace the bulb of the eolipile between them. This eolipile throws out a jet of steam, as we shall describe hereafter.

We must take care that the nozzle or beak of this eolipile should have a very small hole or aperture in it, not larger than the size of a very small pin; and we must put into it either brandy, or alcohol mixed with one half water; and also take care not to fill more than two-thirds of its capacity.

After having charged the spirit-lamp, we place it under the eolipile; this spirit-lamp ought to have a very small wick, composed of only five or six threads of thin cotton wick-yarn; and the flame of it ought not to be farther from or below the bottom of the eolipile than three or four lines.

With such a flame, but when urged by the bellows, we can not only soften glass, but if we operate upon a small quantity at once, we can melt it into small round drops; if we can moisten for instance the point of a fine sewing-needle, we can take up with it a morsel of fine white glass, and presenting it to the edge of the flame, we can fuse it, and cause it to assume the form of a globule; and the

same effect may be produced, if we heat in like manner the end of a slender capillary tube. If these globules be made of glass well selected, and be formed by a skilful hand, they make pretty good and not expensive microscopes, when they are mounted between two thin plates of metal, with very small holes in them: and we know of a person who is very dexterous in these kinds of works. We also know, that M. R. P. la Torre, librarian to his majesty, the King of the Two Sicilies, and a correspondent of the Royal Academy of Sciences, published a work in the year 1763, under the title of the "*Nuove Osservazioni, in torno la Storia Naturale*;" and in which we not only find a curious detail of the manner in which he formed and used these globules, but likewise a set of fine observations, which no doubt it would be easy to repeat.

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XXVI.—On Preparing Hydraulic Cements. By  
M. PASCH\*.

M. PASCH has not only made many experiments during the progress of the canal at Gœtha, in Sweden, on preparing hydraulic cements, but had also done so for several years previously.

In a work prepared by him especially, on the researches in hydraulic cements, he commences from the earliest periods, and also cites the experiments recently made both by the English and the French; finally, concluding with the results of his own experience. M. Pasch tried various species of lime found in Sweden; these he successively mixed with aluminous slate, or schistus, burnt clay, manganese, trapp, grunstein, pulverised granite, and ochre, and has given the results of all these experiments. The author gives the preference to the aluminous schistus (*alunskiffer*). He found it difficult, he says, to mix it with any species of

\* From *Jern-Kontoret's Annaler*, vol. VIII. 1824.; and Ferussac's *Bulletin des Sciences Technologiques*, for Nov. 1828.

lime, without improving the quality of the lime. In order to do this, he burnt it, and reduced it to powder. And thus he produced cements possessed of the necessary qualities of quickly drying, and a great tenacity. The author allows, indeed, that on account of carriage, this substance is rather costly; but he nevertheless thinks, that the great advantages which it produces, will well compensate for the expense of it.

M. Pasch made more than a hundred experiments on manganese, which has been so greatly recommended to be employed in the formation of hydraulic cements; he used it both in its natural and in its calcined state. It has been stated, that we could obtain a good cement from mixing pulverized lime, manganese, clay, and sand together, and well incorporating the mass. He thinks, that in this case, the good quality of the cement is due to the clay, and he could not perceive that any advantage was derived from the manganese, and therefore advises that it be omitted. Neither could he find that much good was obtained from the use of trapp, grunstein, the powder of burnt granite, and ochre; nevertheless, he thinks that the last mentioned substance did a little contribute to the improvement of the cement.

With respect to the various kinds of lime, the author has found that they are all susceptible of being converted into hydraulic cements; but that the lime-stones of the alluvial formation (*flodlagrige*) produced a better lime than those belonging to the older formations. That a considerable portion of argillaceous earth mixed with the lime caused the cement to endure longer under water; that the siliceous earth gave the cement a greater degree of hardness, but did not prevent it from experiencing the effect of water upon it. He found that the bituminous calcareous stones were the best, on account of the portion of aluminous schistus which was contained in all those which the author assayed. The cements made with these kind of limestones became dry in a few minutes, and acquired the hardness of

stone; and he thought they might completely replace the famous Parker's cement.

It was proved, from the following chemical analysis, that the two cement stones contained very near the same substances :—

<i>Calcareous Bituminous Stone, from Matola, in Sweden.</i>		<i>Cement-stone from Harwich.</i>	
	per cent.		per cent.
Carbonate of lime	66,81	Carbonate of lime	66,63
Carbonate of iron	3,49	Mica	2,33
An indeterminable trace of manganese and mica		Carbonate of manganese	3,49
Aluminous schistus	29,54	Oxide of magnetic iron	8,01
	99,84	Aluminous schistus	24,30
Loss	0,16		98,76
	100,00	Loss	1,24
			100,00

It is without doubt desirable, adds the author, to determine the exact proportions in which we should mix the different ingredients to form a good cement, but much depends upon the quality of the lime employed; and as the composition of the different kinds varies so much, so it is not possible to determine the proportions of the other ingredients. M. Pasch speaks of the lime from Faalhafen, which is procured from the lower strata, upon the border of the ocean, as having proved excellent in the works for the Goetha canal; this stone is of a reddish tint, and contains fifty per cent. of lime; the remainder being a siliceous earth mixed with the oxide of iron; and also a little argillaceous earth and oxide of manganese. After being burnt, the stone gave twenty per cent. of pure lime. This lime afforded an excellent cement when prepared in the following manner. Pulverized lime, not slacked, one part by measure; and sand, half a measure; or instead thereof, lime pulverized, and not slacked, four measures; sand, two measures; pulverized aluminous schistus, one measure. For the rest the author is unable to give a general formula for mixing the ingredients of a good cement, but he indicates, at least, the principles according to which the mix-

are should be made. Thus, when the sand and the aluminous schistus have been mixed in proper proportions, the quantity of lime to be added should be such, as that the hydrate of lime should fill all the interstices of the mixture. Before proceeding however to make a good mixture, it is necessary to know many particulars; for instance, the volume of hydrate of lime, which is obtained from a measure of pure lime; the degree of compactness afforded by the sand, and the aluminous schistus to the mixture; and lastly, the capacity of the empty spaces which remain between the particles of sand, &c.

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XXVII.—*On the Swedish Iron Mines and Iron* \*.

The office of the iron mines, in Sweden, is charged with a part of the administration of the mines, and other royalties. In the mines of other countries, there are but few kinds of minerals produced, and those are well known, so that it is easy to calculate with certainty the produce of their ores. In Sweden, on the contrary, the same mine yields many different minerals, and they every year open different beds and veins, from whence results the necessity of constantly making new assays, and this will account for the great number of analyses which are contained in the volume published by their school of mines; and thus, this eighth volume chiefly consists of the chemical analyses of minerals made by the pupils, and also of calculations of the proportions between the forms of their furnaces, the quantity of combustibles employed, and the results of the fusions.

It also contains an account of the experiments made by Mr. Uhr, to prove the strength of bar-iron. He took the bars made at the iron-works of Skebo; these were three feet long, two inches wide, and three quarters of an inch in thickness, and each bar weighed 15.76 Swedish pounds.

\* From the same work as the preceding article.

These were firmly fixed horizontally and edgewise, at one end, into a stout upright piece of timber; and to the other ends the scale of a balance was suspended and loaded with weights. The author gives a table, indicating the different weights required to bend the bars, and which varied from 59.19 Swedish *lispunds*, to 83.04. The quality of the ore from which it was produced, and of the iron in each bar, are also indicated; as likewise a figure given of the machine employed for proving them.

Vol. IX., for the year 1825, part I. contains two reports by M. Uhr; on experiments made at the iron works in Sweden, during the year 1824. These experiments call in question the accuracy of the former reports upon these subjects, made by the pupils of the school of mines, concerning the relations which exist between the furnaces, the quantity of the combustibles employed, and the results of the fusions; and the author gives many tables, containing the results of his own experiments. The second report tends to expose the employment of cylindrical rollers, in the preparation of bar-iron, according to the English method. Hitherto these cylinders have not been much used in the Swedish iron-works, on account of the great expense of the machinery; and it is probable that the Swedes will remain for a long time faithful to the employment of their ancient processes, of forging their iron into bars.

Vol. X., for the year 1826, part I. contains a long report from the mining engineers, with numerous calculations, on the construction of the *tuyeres* and chimneys of smelting-furnaces, on determining their height, their capacities and those of the bellows; and on carrying to a higher degree the fusing powers of charcoal. Another report by M. Uhr, on the commerce of the English in iron, with many tables, founded upon parliamentary documents.

Part II., which forms a volume of 600 pages, bears a special title: *Försök at bestämme valsadt och schmicstaångjerns täthet*; or, "An Essay to determine the Density of Cast and Wrought Iron,"

*sity, Ductility Malleability, Elasticity, and Strength of Bar-iron ; both when passed through Cylinders, and made by the Forge."* This work, so extensive, consists of a long series of experiments, which the Swedes were provoked to make, in consequence of the preference which obtains, in some countries, for the English rolled iron, over that made in the forges of Sweden ; and it was certainly for the interest of this latter kingdom, to make great and numerous experiments upon the subjects. They promise to continue these reports.

*Remarks. By the EDITOR.*

The employment of *cylindrical rollers* in the English iron-works is chiefly valuable for the vast quantity of iron it enabled us to produce : and, no doubt, *most excellent iron may be made by their agency*. At the same time we must ever lament, that it enables the fraudulent manufacturer to imitate the appearance of the best iron ; and it is only by the effects produced upon it in the forge, that the purchaser finds out the difference between good wrought iron, and that which is very little better than *cast iron*, squeezed by rolling into the form of wrought iron. Now the Swedes distinguish the various kinds of their iron by particular stamps or marks, so that the purchaser can always be sure to have it of the quality he wishes, either for *steel-making*, or any other purpose ; and the Swedish government have always made it a point to preserve the integrity of their marks.

The late Samuel Homfray, Esq., one of the greatest iron manufacturers in this country, had it greatly at heart to compel the makers of English iron to adopt a similar practice ; and it had been well for this country had he been enabled to have carried his wishes into effect.

XXVIII.—*On the Persian Method of Managing Silk-Worms\**.

THE Asiatic method of managing silk-worms, is far preferable to that formerly practised on the Aktourba, where much time and expense were wasted in feeding the silk-worms with gathered leaves, which soon decayed, and rendered the frequent shifting of their beds necessary. The Persian or Boukharian rears his mulberry-trees to about six feet high, which they attain in four or five years, he then begins to lop their tops and branches, which are given to the insects, as soon as they have sufficient strength, by placing them gently on their beds. By this means the shoots remain fresh and succulent, and the worms devour them even to their woody fibres, so that no part of the nutritive foliage is wasted. As these insects are every day supplied with food, the leafy branches gradually form a kind of wicker-work, through which the impurities pass, so that the chearful worms preserve the requisite cleanliness without trouble to the cultivator, and speedily obtain a vigorous state. In this manner they are continually supplied with leaves, till they prepare to spin, when small dry brush-wood is placed in all directions over the leafless branches, on this the worms spin their silk. Two persons, an adult, who lops the branches, and a child who collects them, are thus enabled quickly to procure food for a great number of silk-worms.

The mulberry-tree, in our climate, produces new shoots twice in every summer. These shoots acquire, in the same year, the firm consistence of wood. In Persia and Boukharia, where the summer is longer, and vegetation more vigorous, the shoots may be even cut twice a year. The tree, by this method of cutting, always remains low, and produces a greater number of young shoots from its trunk, as well as from its branches, every subsequent year.

\* From Professor Pallas's Travels, Vol. I.

By stripping them of their leaves, however (on the contrary), many branches wither, and not only the buds are lost, and much foliage wasted ; but the worms receive less nourishment, as the leaves sooner decay. It has been remarked, in the silk establishment near Akhtourba, that the worm, when compelled by necessity, eats the leaves of the *Acer Tataricum*, which resemble those of the mulberry-tree.

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XXIX—*On Draining the Lakes and Marshes, in the Duchy of Mecklenburg.\**

BARON DEWITZ, ever since he has been in the Administration, as Privy Councillor, &c. has given the greater encouragement to such schemes as in any way tend to improve the several branches of rural oeconomy.

But in no one article has he been more assiduous than in endeavouring to drain the lakes and marshes, with which this part of Mecklenburg abounds. There are actually a vast number of men employed in draining a part of the lake of Strelitz, and in cutting a navigable canal, by which he intends to open a communication with the Elbe. This is a noble undertaking ; and to his praise it must be said, that he has steadily persevered in it, notwithstanding the opposition of the gentlemen in the several departments of government, who all objected to it, as too expensive, impracticable, and useless. They said he came from England, with his head full of schemes which would never do in this country. But now they begin to open their eyes, and to think that if they had fewer lakes and marshes it would be more advantageous to the prince, and happier for the subject.

Where the population of a country is not very considerable, lakes and marshes generally remain as they are ; but when it increases, and the administration bends its

\* From Nugent's Travels in Germany, Vol. II.

attention to that weighty point, on which the power and prosperity of States may be said in a great measure to depend, nothing more nearly relates to the comfortable dwelling and subsistence of the inhabitants than to procure a more commodious and fertile surface; and then of course the draining of lakes and marshes is taken in hand. That a country with many lakes and marshes is but thinly inhabited, is a conclusion verified by experience, in all nations where the arts and sciences have made any progress. In France, England, and the populous provinces in Germany, as Saxony, Franconia, the Palatinate, the Duchy of Magdeburg, Bavaria, and Lower Austria, there are few or no lakes or morasses of any extent; where as in Denmark, Sweden, Poland, Russia, and in those parts of Germany where the population runs low, as in Holstein, Pomerania, &c. they are by much too common. The Duchy of Mecklenburg abounds with them, from some high grounds we may see seven, or even more. Now, where they are so numerous, it is certainly most beneficial for a state to form as many of them as possible into streams and canals, for the improvement of inland navigation, and to drain the remainder. The draining of lakes and morasses not only supports population, but is a real aggrandizement of a state, infinitely preferable to conquests, for it diffuses blessings and prosperity over a country.

Draining employs a great number of hands, and by the acquisition of fertile land the products of the country are multiplied; now these are considerable advantages, which would compensate for the charges of the undertaking, without any other view. But the addition of subjects, arising from this increase of land, would soon augment the public revenue.

I have had several conversations with the engineer employed in draining lakes and morasses in this country; he is a very able and communicative man; so that I have had an opportunity of knowing from him in what manner this operation is conducted.

The nature of the lake having been narrowly examined into, they proceed to obtain as exact a knowledge of its bottom ; as whether it be muddy and earthy, or rocky and stony ; in the last case it will not answer the charges of draining ; though, for an inland lake to have a rocky bottom, would be something very extraordinary, if not impossible, in the nature of things ; for, in the space of some hundreds of years, such a quantity of earthy and slimy particles must have subsided, as to cover it with a fat and fruitful soil to the depth of a yard, and such a depth is sufficient for cultivation.

The depth of the lake, and the possibility of draining it, are considered in every light, the draining a lake of very considerable depth being impracticable. An exact survey is likewise taken of the slope of the neighbouring country, for determining which way the water from the lake is to take its course ; likewise whether the water can be carried off by trenches alone, or whether engines must not also be procured, for raising it out of the greatest depths ; and this being done, the depths to be filled up, and brought to a level with the ground. Besides examining into the possibility of the draining, and forming a plan of the method of conducting it, another important article is, a just estimate of the expenditure. Both the plan and estimate pass through the hands of several persons, well acquainted with such works, they never committing so important a concern to one single man, however famous for his capacity. Farther, the plan and estimate are shown to proper persons, desiring their opinions and exceptions, and where they seem weighty, the projector is to answer them, and submit his defence to farther objections. After the scheme is approved, the undertaker engages to do it completely, at the lowest rate, and at the same time gives securities for the due performance of the contract. He then sets about his work in the following manner : first, he sinks some broad and deep trenches, according to the slope of the country, from the lake, to the river or brook into

which the drain is to be carried. These trenches being finished, and the disposition of them with regard to the slope very carefully examined, the little space left between the trenches and the lake is bored through, which gives an outlet to the water. As the water decreases in the lake, the trenches are carried farther towards the middle of it, in order to form the main trench which traverses the lake; and whilst these trenches advance, a dam is made against any irruption of the water, till things are ready for the dam being bored through to make a farther discharge.

This is the general method by which all the water is carried off. But in case of meeting with a very deep bottom in the middle, from which the water cannot be drained by the trenches, without making them of an enormous depth, the water is raised by engines, and of those the best are such as work both by wind and horses. Next to the main trench through the lake, which is generally a perch in width and depth; another of somewhat smaller dimensions is carried round the lake, and at about every thousand paces there is a cross drain, all terminating in the main channel.

The draining of marshes is conducted much in the same manner as that of lakes; but here I have seen the operation performed only on what we call moor, or turf grounds; these are most easily drained by carrying trenches through those grounds, when the disposition of the country is such, that the water can be conveyed to some neighbouring stream. The first thing they do is, to carry a ditch to the middle of the moor, in a straight direct line; its depth and breadth being adapted to the extent and wetness of the ground, and thus to the supposed quantity which is to be drained off. Every six, eight, or ten perches, as the ground is more or less swampy, cross-trenches, on both sides are drawn in a direct line, and communicating on both sides, with the main trench. But in case of water coming from any neighbouring eminences, they dig a trench round the whole ground as a reservoir, and this like-

wise communicates with the main trench. These trenches are made wider at the top than at the bottom, that the banks may be less liable to give way, and thus spoil the drains. It is likewise customary, for the better security of the work, to set poles or hedges along the banks; osier twigs will answer this purpose, setting them crossways, and about four or five feet above the water. If these twigs are topped the first year, so that they may not hold much wind, and thus shake the roots, they will thrive very well, and strengthen the banks; and if these osiers are not to stand, they may be hewn down at the end of five or six years; as by that time, their roots having struck deep, will afford a good binding to the ground. The earth from these trenches being generally very good, is spread on the grounds that are to be drained; but the sods, turf, and moss-clods, if the turf cannot be used for fuel, are turned about, or placed in heaps, in order to their quicker putrefaction for manure, as above. In case the draining of the water into some natural receptacle be not practicable, at least not under a very considerable expense, then they have recourse to sinking ponds or reservoirs in some neighbouring bottoms, and to these they carry all the trenches. These ponds may likewise be of use as a fishery; but if even the sinking of such a pond be too chargeable, there still remains an expedient which is of good effect, and chiefly if the moors are not too wet or marshy. It is the nature of moors in general, that beneath the turf or moss there is a loam, which hinders the moisture from penetrating, and this indeed is what makes the marsh, and causes the luxuriant growth of the turf and moss; but this loam or clay is only a stratum, and far from being of an immense depth; under it is generally a sand, or some other stony or loose soil. Here reason readily informs us, that a middling morass may be drained by perforating the clay, and thus making way for the moisture to penetrate. In order to this, a pit is dug in the deepest part of the moor, till they come below the obstructing clay, and meet with such a

spongy stratum, as, in all appearance, will be sufficient to imbibe the moisture of the marsh above it. Into this pit the ebbing of the morass is conveyed through a trench, and both the trench and the pit are filled up, after the draining, with large broad stones, setting them edgewise, so as to leave interstices for carrying off the water; then such stones are laid over them breadthways, and these are covered with a loose earth like that on the surface. Where no such stones are to be had, strong piles are rammed down the sides of the trench, and broad boards laid across it, and these are covered with earth to a depth fit for culture. This is a matter of no great expense, the pit being as near to the morass as the water will permit, and the trenches but short. Thus they have a drain unperceived, which leaves the surfaces of the trenches fit for the plough; and in middling marshes, and especially in such moors as are only wet and damp, this method, though something slow, never fails of taking effect; and many tracts are thus made serviceable for the use of the farmer or grazier.

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### XXX.—MISCELLANEOUS.

*On destroying bugs in Canadian pine timber.*—The Editor lately mentioning to Mr. B. Bevan, the celebrated engineer, the great annoyance caused by the new species of bug imported with this timber, he stated that he had built a house, the floors of which consisted of Canadian pine, but had never heard of any complaint of a similar nature being made in consequence thereof. However, upon recollection, he said, that in order to season the planks, he had *steamed them*.

Now this *steaming* was the most effectual measure he could possibly have taken to destroy, not only the bugs in the timber, but their eggs also, as the heat of steam or boiling-water is inevitably fatal to animal life. We can therefore safely recommend this judicious process

to all who may have occasion to employ this timber in flooring; both as a means of seasoning it, and more especially with a view to the destruction of those domestic plagues, the bugs.

*On seasoning box-wood for sliding-rules, &c.*—Since writing the article in a late number, on Mr. Downing's improvements in the manufacture of sliding-rules, Mr. William Jones, the long established optician and instrument maker, of Holborn, informed the Editor, in consequence of his mentioning to him Mr. Downing's compound plane for shooting the slides true, that he had long made the improved sliding-rules, for the use of the engineers in the employment of Messrs. Boulton and Watt, of the Soho, near Birmingham, and found the greatest difficulty in preventing them from shrinking and warping. That he was under the necessity of having them cut out, and laid by for *three years*, to season them, frequently planing them smaller from time to time, to expose fresh surfaces to the action of the air; and even then, the wood was still liable to shrink. That ivory was still less to be depended on; and that brass was the fittest material for the slides.

*On the discovery of a new cavern with bones, containing human remains, mixed with those of antediluvian animals* \*.—M. Cordier communicated to the *Academy des Sciences*, on the 9th inst. the results, to which the examination of a cavern, containing bones, lately discovered near the small town of Bire, in the eastern part of the *departement des Landes*, has led, as stated in a letter from M. Tournel, jun. of Narbonne (the gentleman engaged in the examination), to M. Cordier.

“ The mountain is calcareous, and appears to belong to the old formation, known by the name of the *Oolitic* formation, or the formation of the Jura mountains. The fossil bones are contained, either in a stony concretion (*concrétion pierreuse*), or in a black mud. Those of the black mud differ entirely from the fossils found in the caves of

\* From “ *Le Globe*.” Paris, Feb. 1829.

Germany, England, Lunel, Viel, and in the alluvial deposits of the *Val-d'Arno*, the mountains of Renes, of Pizanas, and others of the same kind. What is extremely remarkable, is the fact, that *human bones* are found buried in the midst of those of lost animals, in the black mud, and also amongst those which, by their mixture with the beds of calcareous concretions, constitute a true osseous breccia. Fragments of pottery, land-shells, not now existing in that country, and marine shells, are also found in the same place.

" M. Tournel is about to publish a description of this interesting cavern, in conjunction with that able naturalist M. Marcel de Serres, from which we may expect a satisfactory determination, whether the bones mentioned in M. Tournel's letter be human or not; and if they be, whether really fossil, and of an origin probably contemporaneous with that of decidedly fossil organic remains; or merely a comparatively recent deposit.

" We must own (says the Editor of "*Le Globe*," ) that the fragments of pottery found with them, give, in our opinion, a very suspicious character to their claims to an antediluvian origin."

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## LIST OF PATENTS FOR NEW INVENTIONS.

*Which have passed the Great Seal since Jan. 23, 1829.*

To John Hopper Carrey, of Aylesbury-street, in the parish of St. John, Clerkenwell, in the county of Middlesex, goldsmith and jeweller; for certain improvements in the construction of umbrellas and parasols. Dated Jan. 27, 1829.—To be specified in two months.

To James Fraser, of Limehouse, in the county of Middlesex, engineer; for a new and improved arrangement of a flue or flues, to communicate with the various parts of culinary apparatus; such as steam, soup, or water boilers; oven or ovens; hot-plate or

plates; hot closet or closets; and stewing stove or stoves; to render them more compact; and also to appropriate part of the said apparatus to effect other useful purposes. Dated Jan. 27, 1829.—In two months.

To John Braithwaite, and John Ericsson, of the New-road, Fitzroy-square, in the county of Middlesex, engineers; for a mode or method of converting liquids into vapour or steam. Dated Jan. 31, 1829.—In six months.

To Robert Parker, of Hackney, in the county of Middlesex, a lieutenant in the Royal Navy; for an improved drag, or apparatus, which is applicable to stage-coaches, and other wheel-carriages; and whereby the motion thereof may be retarded or stopped, when required. Dated Jan. 31, 1829.—In two months.

To Joseph Rayner, of Kings-square, in the parish of St. Luke, Old-street, in the county of Middlesex, civil engineer; for certain improvements in apparatus and machinery, for conducting heat and applying the same in the operations of washing, scouring, cleansing, fulling, dressing, dyeing, and finishing woollen cloths; and in callendering, straining, glossing, polishing, and finishing silks, cottons, linens, woollens, and all other goods, to which the same may be applicable. Dated Feb. 5, 1829.—In six months.

To Julius Pumphrey, of Tally-hill, in the county of Worcester, glover; for certain improvements in steam-engines, and machinery connected therewith, to propel steam-boats, and vessels; some parts of which improvements are also applicable to other purposes. Dated Feb. 3, 1829.—In two months.

To John Burgis, of Maiden-lane, in the parish of St. Paul, Covent-garden, and county of Middlesex, ornamental paper manufacturer; for a method or methods of gilding or silvering certain woven fabrics, in burnished, or burnished and dead, or matted gold and silver; and which said fabrics may be used as gold or silver, and lace borderings, and for other purposes. Dated Feb. 5, 1829.—In two months.

To Alexander Daninos, of 21, Leman-street, Goodman's-fields, in the county of Middlesex; for a certain invention for the manufacture of improved hats and bonnets, in imitation of Leghorn

straw hats and bonnets, which invention was communicated to him by a foreigner residing abroad. Dated Feb. 5, 1829.—In six months.

To Richard Green, of Blackwall, in the county of Middlesex, ship builder; for certain improvements in the construction of made masts. Dated Feb. 5, 1829.—In four months.

To William Henry Kitchen, of High-street, in the parish of St. Giles, Bloomsbury, in the county of Middlesex, ironmonger; and Andrew Smith, of York-terrace, in the parish of St. Margaret, in the city of Westminster, merchant; for certain improvements in the construction of window-frames, sashes, or casements, shutters, and doors, designed to afford security against burglars, as well as to exclude the weather. Dated Feb. 7, 1829.—In six months.

To Edward Heard, of Devonshire-street, Vauxhall-road, in the parish of Lambeth and county of Surrey, chemist; for a certain improvement or improvements in illumination, or producing artificial light. Dated Feb. 12, 1829.—In six months.

To Samuel Walker, of Beeston, in the parish of Leeds, in the county of York, cloth manufacturer; for an improved apparatus, which he denominates "an Operameter," applicable to machinery for dressing woollen or other cloths. Dated Feb. 20, 1829.—In six months.

GILL'S  
TECHNOLOGICAL & MICROSCOPIC  
REPOSITORY.

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XXXI.—*On the Microscope.* By the EDITOR.

(Continued from page 139.)

*On the animalcula termed the urslet.*—This little creature has been variously described by writers; some have likened it to the animal called the sloth, and others to the bear; and some have even stated that it has only six legs, whilst in fact it has eight. It is by no means common either in England or Scotland, and therefore it cannot but be gratifying to those amateurs of the microscope who reside in this metropolis to be informed, that it is to be found in a pond in the immediate vicinity of the Regent's Park. We owe this intimation to a friend, whom, an admirer of the microscope, Mr. Powell, informed of the situation of the pond; and accordingly, after, however, making one attempt in vain to find it, on the second trial we were fortunate enough to succeed, and to bring away with us specimens of this minute and curious animalcula.

This urslet is rather larger than the wheel-animalcula, and is in the form of a caterpillar with a rounded head; it generally lies upon its side, or its back, and in one situation only, and is continually moving its legs, which are each of them armed with four sharp claws, as if endeavouring to seize or grasp at something above it. It has two very small black eyes, and a mouth placed underneath its head, and generally lies amongst the slime at the bottom of the vessel in which it is kept, and therefore requires to

be raised upon the webbed end of a small feather or quill, and placed in the small and shallow pond, formerly and repeatedly described by us, in order to view it under the microscope, when surrounded with water, and covered with a very thin slip of Bohemian plate-glass. In this state, and with a lens of the twentieth of an inch focus, its singular movements may be conveniently observed.

The pond from which we procured these animalculæ, is situated in a field upon the right hand side of, and adjoining to, the road, leading from the Regent's Park, over the first Regent's canal bridge, towards Primrose Hill, and immediately after having crossed the upper end of Park Street, Camden Town. It is formed in the clay, and can therefore only be supplied with rain water. A quantity of *lemna* or duckweed floated upon the top of the water, and we brought away with us a quantity of it, together with the water it had imbibed, in a small vessel; and, upon examination under the microscope on our return home, we had the satisfaction of finding the long sought *urslets* contained in the deposit which had settled at the bottom of the water drained from the *lemna*.

*On the green polype.*—Having placed the greater part of the abovementioned *lemna* upon the top of the water contained in a cylindrical glass vessel, of about three inches in diameter, and six inches in height, in which we had preserved the brown or flesh-coloured polypes, presented to us by our friend Mr. Thomas Carpenter, through the winter, with a view of furnishing them with food; we were agreeably surprised, at finding, on the examination of the glass vessel next day, that several of these beautiful green polypes had quitted the *lemna*, and had affixed themselves upon the sides of the vessel, intermingled with its former occupants, the flesh-coloured ones: so that our readers may now likewise be able to furnish themselves with a supply of these interesting microscopic objects.

*On the larva of the ephemera marginata.*—Amongst a variety of other larvæ, contained in the above-mentioned

*lemna*, we have found that of the *ephemera marginata*, which forms one of the beautiful subjects, so admirably displayed in Goring and Pritchard's first number of their work, "On Living Objects for the Microscope;" and we are informed by Mr. Philip Carpenter, of Regent Street, that just before last winter, Mr. Powell had furnished him, from the above pond, with specimens of that curious species of larva, of a straw-coloured plumed culex or gnat, which forms the subject of the other plate in Goring and Pritchard's work; and similar to that indeed, which had constituted one of the most attractive objects displayed in Mr. P. Carpenter's exhibition of his superior solar microscope last summer.

*On orange-coloured wheel-animalculæ.*—In the above-mentioned *lemna* we have also found several wheel-animalculæ, of the kind lately mentioned by us, but of an *orange-colour*, instead of being of their usual whiteness. Can this change of colour be owing to a difference in their food?

*On the microscopic jointed nais.*—We have also found a very fine specimen of this beautiful though minute worm in the water contained in the *lemna* brought from the above-mentioned pond; in short, we have never yet met with so many various and interesting living microscopic objects contained in one collection before; and if it abounds with such numbers at this unseasonable period of the year, and just after winter, what may we not hope to find in it in more genial seasons.

We believe, that the method which we had taken, upon the suggestion of Mr. Gray, of the British Museum, of bringing home the moist *lemna*, and the animalculæ enclosed within it, instead of bottles of the water, as is the general practice, and whereby we had frequently failed in preserving polypes alive, even till the next day, owing to their having been injured by the shaking and agitation of the water in the bottles, to be as effectual and convenient a method as we could have adopted for the purpose, and can

therefore recommend it to the adoption of others: Mr. T. Carpenter has suggested to us the employment of an oil-skin bag, similar to those used to contain wet sponges, as being a very convenient and portable vehicle for holding and bringing home the lemna, conferva, chara, or other aquatic plants, together with the animalculæ contained in the water they had imbibed. Mr. Gray employed, for a similar purpose, a tin box, ordinarily used by him to carry sandwiches in whilst travelling.

*On the late Dr. Wollaston's microscope, made by Mr. Dollond.*—We have recently been favoured by J. G. Children, Esq. of the British Museum, with a sight of this instrument, and its effects. It consists of a brass tube, about an inch in diameter, and seven inches in length, screwed in an upright position into a screwed cell, fitted upon the top of the mahogany case of the instrument, and in the centre of it. Near to the bottom of this tube, an oval aperture is formed upon one side of it, which permits the light to fall upon a plane mirror, mounted upon pivots, which project through holes made in the sides of the tube, so as to permit of various inclinations being given to the mirror as usual. Immediately above the mirror, a diaphragm or stop is placed, to cut off the extraneous rays of light, and that which passes through the diaphragm is condensed, by means of a plano-convex lens, mounted near to the top of the tube, and just below the objects to be viewed in the microscope, the lens being adjustable, by means of two upright slits, formed in the sides of the tube, and through which two pins pass, with milled-heads upon their external ends, and thus enable the observer to vary the light at pleasure. In this manner the light is conveyed in a most satisfactory way, and the objects are illuminated in a most superior method. The stage is mounted upon the top of the tube, and is furnished with crossing movements, actuated by means of screws, with milled-heads to them, so as to follow the movements of animalculæ, or to bring various objects into view with great fa-

cility, and which are placed upon flat circular glasses, fitted into a circular recess or cell, provided in the stage for that purpose. The object glasses are held in another cell, mounted upon the external end of an arm, placed at the top of the tube or stem of the instrument; and the focal distances of the objects are adjusted by means of an upright fine-threaded screw, with a milled-head upon its lower end, which acts upon a female screw, mounted upon the tube or stem upon one side of the stage; and its upper end is connected with the arm carrying the object glasses.

The object glasses are either single lenses, or combination of two plano-convex lenses, mounted in a cell, with their plane sides downwards.

The performance of this microscope was exceedingly satisfactory, the difficult markings of the scales of the podura, and of the longer ones of the brassica butter-fly, described and figured by us, being most perfectly defined; and as these rank among the most difficult test objects, so there can be no manner of doubt but others will yield to its powers.

*On Mr. William Tulley's single microscopes.*—Mr. Tulley is now employed by R. Brown, Esq. of the British Museum, to make some single microscopes for him: the stages of these instruments possess the crossing-powers, for enabling the observer to follow the motions of animalculæ, &c., now so generally adopted in microscopes; but the adjustment of their focal distances is effected in a novel manner. This is as follows:—

The rough adjustment of the stage is effected by means of a rack and pinion, much in the usual manner; but the nice adjustment is produced by means of a bevel-pinion acting in the teeth of a horizontal bevel-wheel, which is affixed upon the lower end of an axis, having a fine single-threaded screw; and which, passing up through the centre of a tube, sliding within the pillar or stem of the microscope, acts in a female screw affixed to the carrier of the lenses, and thus effects that nice adjustment, so necessary.

to be obtained in using the higher powers of single microscopes.

*On Mr. William Tulley's achromatic microscopes.*— Since our last number was published, we have been twice gratified by the sight of two of these excellent but nearly unique instruments; as, on account of the very great difficulty attending the working and combining the six lenses forming the achromatic object-glasses, it is not very likely that many of these microscopes will ever be constructed. The first of these instruments we saw in Mr. Tulley's own hands, at his father's residence in Islington, and were highly gratified with its performance; and the second in Mr. Lister's possession, for whom Mr. W. Tulley had constructed it, at the residence of J. G. Children, Esq. in the British Museum; and where it had attracted several amateurs and makers of microscopes, who felt a considerable degree of interest in testing its effects, in displaying several difficult test subjects, both as transparent and opaque objects. Amongst these we may mention the scales of the podura, and the longer ones of the butterfly of the brassica, as well as those of the Menelaus papilio, and of other foreign ones, whose names were not ascertained at the time, and all of which were shown highly magnified, and in a most satisfactory manner indeed.

The achromatic lenses in these microscopes are combined in threes, after the manner of those used in telescopes, namely, two double convex lenses, including a double concave one between them; and hence the great difficulty of working and combining them may be readily conceived. Their magnifying powers are varied by means of different astronomical eye-pieces, and they can thus be extended to wonderful degree at pleasure.

Mr. Lister exhibited to us the hairs upon the feelers of a spider, both as a transparent and as an opaque object; and in the latter case he showed us that those hairs, which, when viewed as transparent objects appeared to have a smooth surface, were in fact serrated, or covered all over

with minute teeth, exactly resembling those of a fine rasp!

*On the globules of the blood.*—Mr. Lister exhibited to us in his Tulley's achromatic microscope, and under highly magnifying powers, the singular discovery made by him, that the globules of the blood congeal into flat circular bodies, and arrange themselves in rows, one body being placed partly underneath another, and in like manner as a pile of similar coins, when thrown gently down, would be found to arrange themselves. This curious effect he attributed to the vitality yet remaining in the blood, during the act of congealing. At any rate it is a most singular fact; for although we might naturally conceive that the flattened circular plates would place themselves in juxta-position, yet we never could have supposed that they would have partly slipped underneath each other, as proved to be the fact.

In order to make this curious experiment, it is necessary that the blood, as freshly drawn, be slightly and thinly smeared over the surface of a slip of crown, or window-glass, and be covered with a very thin slip of Bohemian plate-glass; and thus some slight inequalities in the thickness of the layer of blood between them will be produced, and which are necessary to succeed in producing the very curious appearances above mentioned.

It may also be necessary to repeat, that highly magnifying powers are absolutely necessary to be employed in exhibiting this object. Upon our return home, we found that the lens of our Varley's microscope, the fiftieth of an inch focus, enabled us to discover similar effects in blood, to those we had just before witnessed in Mr. Lister's microscope.

*On the farina of the salvia coccinea, or scarlet sage.*—Mr. Lister showed us this beautiful farina in his Tulley's microscope, both as a transparent and as an opaque object. It is in the form of semi-transparent spheres, surrounded with zones or belts, and affords an interesting sight under the microscope.

(To be continued.)

**XXXII.**—*On the Locust, Mantis, Cicada, and some English Insects.* By THOMAS CARPENTER, Esq.

WITH A PLATE.

DEAR SIR,

*London, March 16, 1829.*

SOME years since, I purchased at a sale, a box, containing mutilated specimens of the locusts, mantes, cicadas, and other foreign insects; in the same box were also shells, minerals, &c., the whole of which being loose in the box, the insects were consequently so spoiled, as to be unfit for my cabinet, or indeed for almost any other purpose; however, I thought that if some of their parts were carefully dissected, they might furnish me with a few interesting objects for my microscope.

I had often heard and read of the devastations committed by locusts, but had never paid any attention to the anatomy of them. On minutely examining, however, the head of one in the said box, I found it to be peculiarly fitted and furnished for its work of destruction. It is armed with two pair of very strong jaws, the upper one terminating in short, and the lower in long and powerful teeth, by which it can both lacerate and grind its food. One of these insects I measured, and found it to be full four inches long; and the wings, when expanded, measured from tip to tip eight inches!—Before I proceed to give you the result of my investigations, perhaps some well authenticated facts, respecting these wonderful creatures, may be interesting to yourself and readers.—When they take the field, it is said that they have a leader at their head, whose flight they observe, and pay a strict regard to all his motions. They appear at a distance like a black cloud, which, as it approaches, gathers upon the horizon, and almost hides the light of day. It often happens, that the husbandman sees this imminent calamity pass away without doing him any mischief; and the whole swarm proceeds onward, to settle upon some less fortunate country.

In those places, however, where they alight, they destroy every green thing, stripping the trees of their leaves, as well as destroying the corn and grass. To use the expression of the husbandman, *they burn whatever they touch*, and leave the marks of their devastation for three or four years ensuing. Orosius tells us, that in the year of the world, 3800, Africa was infested with multitudes of them. After having eaten up every thing that was green, they flew off, and were drowned in the sea; and being washed on shore, they caused such a stench, as could not have been equalled by the putrefying carcasses of one hundred thousand men! In the year 1650, a cloud of locusts was seen to enter Russia in three different places; and from thence they spread themselves over Poland and Lithuania in such astonishing multitudes, that the air was darkened, and the earth was covered with their numbers.

In some places they were seen lying dead, heaped upon each other, to the depth of four feet; in others, they covered the surface like a black cloth; the trees bent with their weight, and the damage which the country sustained exceeded computation. In Barbary their numbers are formidable; and Dr. Shaw was a witness to their devastations there in 1724. Their first appearance was in the latter end of March, when the wind had been southerly for some time. In the beginning of April their numbers were so increased, that in the heat of the day they formed themselves into large swarms, that appeared like clouds, and darkened the sun. In the middle of May they began to disappear, retiring into the plains to deposit their eggs. In June the young brood began to make their appearance, forming many compact bodies, of several hundred yards square; which afterwards marching forwards, climbed the trees, walls, and houses, eating every thing that was green in their way. The inhabitants, to stop their progress, laid trenches all over their fields and gardens, which they filled with water. Some placed large quantities of heath, stubble, and such like combustible matters, in rows, and

set them on fire on the approach of the locusts. But all this was to no purpose, for the trenches were quickly filled up, and the fires put out, by the great numbers of swarms that succeeded each other. A day or two after one of these was in motion, others that were just hatched came to glean after them, gnawing off the young branches, and the very bark off the trees. Having lived near a month in this manner, they arrived at their full growth, and threw off their worm-like state, by casting their skins. To prepare themselves for this change, they fixed their hinder part to some bush or twig, or corner of a stone, when immediately, by an undulating motion, used on this occasion, their heads would first appear, and soon after the rest of their bodies. The whole transformation was performed in seven or eight minutes' time, after which they remained a little while in a languishing condition; but as soon as the sun and air had hardened their wings, and dried up the moisture that remained, after casting off their sloughs, they returned to their former greediness, with an addition of strength and agility. But they did not long continue in this state before they were entirely dispersed. After laying their eggs, they directed their course northward, and probably perished in the sea.

These insects are used as food by the Moors, who go to hunt them; they fry them in oil or butter, and sell them publicly at Tunis and other places. They are frequently made use of in various parts of the world as an article of food; they are eaten both fresh and salted, in which last state they are publicly sold in the markets.

It is well known that different interpretations have been given of the passage in the sacred writings, in which John the Baptist is said to have fed on locusts and wild honey. Some have supposed it to mean the young shoots of vegetables rather than locusts; but since the fact is established, that these insects are still eaten by the inhabitants of the East, there seems not the least reason for admitting any other interpretation than the usually received one. Why

should we wonder that the abstemious prophet, during his solitary seclusion from the commerce of the world, should support himself by a repast, which is to be numbered, not indeed amongst the luxuries of life, but merely to be regarded as a substitute for food of a more agreeable nature. We may also adduce, in support of this idea, the testimony of Hasselquist, who thus expresses himself on this very subject: "Those who deny insects to have been the food of this holy man, urge, that this insect is an unaccustomed and unnatural food; but they would soon be convinced to the contrary, if they would travel either to Egypt, Arabia, or Syria, and take a meal with the Arabs. Roasted locusts are at this time eaten by the Arabs, at the proper season, when they can procure them; so that, in all probability, this dish had been used in the time of St. John. Ancient customs are not here subject to many changes, and the victuals of St. John are not believed unnatural here; and I was assured by a judicious Greek Priest, that their church had never taken the word in any other sense; and he even laughed at the idea of its being a bird or a plant. All the Arabians, whether living in their native country, or in Persia, Syria, and Africa, are accustomed to eat locusts; the Turks, on the contrary, have an aversion to this sort of food. If the Europeans express any thing of the same aversion, the Arabians remind us of our fondness for oysters, crabs, and lobsters. A German, who had long resided in Barbary, states, that the flesh of this insect tasted like the small sardine of the Baltic Sea, which is dried in some towns in Holstein. Locusts are caught, and put into bags, or on strings, to be dried, in several parts of Arabia. In Barbary they are boiled, and then dried upon the roofs of the houses. The Bedouins of Egypt roast them alive, and devour them with the utmost voracity. There does not appear any instance of unwholesomeness in this article of food. The Jews in Arabia are convinced that the fowls, of which the Israelites eat so heartily in the deserts, were only clouds of locusts; and laugh at our

translators, who have supposed that they found quails, where quails never were. Of the innumerable multitudes of these insects, that infested the interior of Southern Africa, in the year 1797, Mr. Barrow says, that in the part of the country where he then was, for an area of near two thousand square miles, the whole surface of the ground might be said to be covered with them. The water of a very wide river was scarcely visible, on account of the dead carcasses that floated on the surface, drowned in the attempt to come at the reeds that grew in it. They had devoured every blade of grass, and every green herb, except the reeds. The year 1797 was the third of their continuance in Sneuwberg; and their increase, according to Mr. Barrow's account, had far exceeded that of a geometrical progression, whose ratio is a million.

For ten years preceding their present visit, this district was entirely free from them. Their former exit was somewhat singular. All the full grown insects were driven into the sea by a tempestuous north-west wind, and were afterwards cast upon the beach, where it is said they formed a bank of three or four feet high, that extended for a distance of nearly fifty English miles; and it is asserted, that when this mass became putrid, and the wind was at south-east, the stench was sensibly felt in several parts of Sneuwberg, distant at least one hundred and fifty miles. In Kirby and Spence's Introduction to Entomology, it is stated that St. Augustine mentioned a plague to have arisen in Africa from the above cause, which destroyed no less than eight hundred thousand persons in the kingdom of Masanissa alone, and many more in the territories bordering upon the sea. From Africa this plague was occasionally imported into Italy and Spain, and a historian, quoted in Mouffet, relates, that in the year 591, an infinite army of locusts, of a size unusually large, grievously ravaged part of Italy; and being at last cast into the sea, from their stench arose a pestilence, which carried off near a million of men and beasts. In the Venetian territory

also, in 1478, more than thirty thousand persons are said to have perished in a famine, occasioned by these terrific scourges. Even this happy island, so remarkably distinguished by its exemption from most of those plagues, to which other nations are exposed, was once alarmed by the appearance of locusts. In 1748, they were observed here in considerable numbers, but providentially they soon perished without propagating. These were evidently stragglers from the vast swarms, which in the preceding year did such infinite damage in Wallachia, Moldavia, Transylvania, Hungary, and Poland. One of these swarms which entered Transylvania in August, was several hundred fathoms in width (at Vienna the breadth of one of them was three miles) and extended to so great a length, as to be four hours in passing over the Red Tower; and such was its density, that it totally intercepted the solar light; so that when they flew low, one person could not see another at the distance of twenty paces.

A similar account had been given Mr. Kirby, by a friend of his, long resident in India. He relates, that when at Poonah, he was witness to an immense army of locusts, which ravaged the Mahratta country, and was supposed to come from Arabia (this, if correct, is a strong proof of their power to pass the sea under favourable circumstances) The column they composed, his friend was informed, extended five hundred miles; and so compact was it when on the wing, that, like an eclipse, it completely hid the sun; so that no shadow was cast by any object; and some lofty tombs, distant from his residence not more than two hundred yards, were rendered quite invisible. This was not the *gryllus migratorius*, but a red species of locust, which circumstance much increased the horror of the scene; for, clustering upon the trees, after they had stripped them of their foliage, they imparted to them a sanguine hue. The peach was the last tree that they touched.

From 1778 to 1780, the empire of Morocco was terribly devastated by them; every green thing was eaten up; not

even the bitter bark of the orange and pomegranate escaping. A most dreadful famine ensued. The poor were seen to wander over the country, deriving a miserable subsistence from the roots of plants; and women and children followed the camels, from whose dung they picked the indigested grains of barley, which they devoured with avidity: in consequence of this, vast numbers perished, and the roads and streets exhibited the unburied carcases of the dead. On this sad occasion, fathers sold their children, and husbands their wives. When they visit a country, says Mr. Jackson, speaking of the same empire, it behoves every one to lay in provisions for a famine, for they stay from three to seven years. When they have devoured all other vegetables, they attack the trees, consuming first the leaves and then the bark. From Mogador to Tangier, before the plague in 1799, the face of the earth was covered by them. At that time, a singular incident occurred at El Araiche. The whole region, from the confines of Sahara, was ravaged by them; but on the other side of the river El Kos, not one of them was to be seen, though there was nothing to prevent their flying over it. Till then they had proceeded northward; but upon arriving at its banks they turned to the east, so that all the country north of El Araiche, was full of pulse, fruits, and grain, exhibiting a most striking contrast to the desolation of the adjoining district. At length, they were all carried, by a violent hurricane, into the western ocean; the shore, as in former instances, was covered by their carcases, and a pestilence was caused by the horrid stench which they emitted; but when this evil ceased, their devastations were followed by a most abundant crop. The Arabs of the desert, "whose hands are against every man," and who rejoice in the evil that befalls other nations, when they behold the clouds of locusts proceeding from the north, are filled with gladness, anticipating a general mortality, which they call El Khère (the benediction); for when a country is thus laid waste, they emerge

from their arid deserts, and pitch their tents in the desolated plains. Mr. Kirby proceeds to observe, that although a single individual can effect but little evil, yet when the entire surface of a country is covered by them, and every one makes bare the spot on which it stands, the mischief produced may be as infinite as their numbers. So well do the Arabians know their power, that they make a locust say to Mahomet, "we are the army of the great God; we produce ninety-nine eggs; if the hundred were completed, we should consume the whole earth, and all that is in it." When these creatures contend with the two-legged destroyers of the human race, for proud pre-eminence in mischief, it will be difficult to determine to which the palm should be decreed; and we must admire the propriety with which, in certain passages of holy writ, these insects are selected as symbols of the great ravagers of the earth, of our own species. Thus far I have furnished you with a few well attested facts respecting the scourges produced by the locusts. I now proceed to point out to you some of the organs by which so much mischief is produced; for which purpose, I send you several of the locust's heads dissected, and when you have examined them, you will be satisfied of their capability. One is from the *gryllus migratorius*, or wandering locust; the mouth of this is completely covered by the upper and under lip, as it would be, when not feeding, and in a state of rest. Another, showing the mouth partly open, within which are seen the powerful grinding and cutting teeth. Two other heads with the upper and under lips thrown back, in order to render visible the jaws and teeth, which are of an astonishing strength and size, and also to show the manner in which these powerful grinders fit into each other; together with various parts of other heads, you will also find two of the grinders taken out to be examined separately; and between two slips of glass, are placed a dissection of their compound eyes, consisting of many thousand distinct ones. You will observe the cornea to

be composed of several plates or lamina, and each plate to be studded with an equal number of lenses, in each of which, any object may be distinctly seen; and between the same slips of glass are some bundles of muscular fibres taken from the thorax, in which the curious structure of them is very plainly seen. The stomach I found to be of extraordinary capacity and power; the texture of it is very strong, and singularly marked: this was full of indigested vegetable substances. A portion of this stomach I send you, placed between two slips of glass, for your examination. I also send you the dissected heads of a species of mantis, the *mantis religiosa*; in which you will perceive large and sharp cutting teeth; also strong grinding ones, similar to those in the heads of the locusts. The grinders I have partly separated from the jaws, in order to show the balls at the ends, which fit into sockets in the jaw. These insects are capable of doing very serious mischief. This insect is nearly three inches in length, of a slender shape, and in its sitting posture, is observed to hold up the two fore legs, slightly bent, as if in an attitude of prayer, and hence its name; for this reason the superstition of the vulgar has conferred upon it the reputation of it being a sacred insect; and a popular notion has often prevailed, that a child, or a traveller, having lost their way, would be safely directed, by observing the quarter to which the animal pointed, when taken into the hand. Its real disposition, however, is very far from peaceable, it preying with great rapacity on any of the smaller insects which fall in its way, and for which it lies in wait, with anxious assiduity, in the posture first mentioned, seizing them with a sudden spring, when within its reach, and devouring them. It is, in fact, of a very ferocious nature, and when kept with another of its own species, in a state of captivity, will attack its neighbour with the utmost violence, and persevere till one or the other of them is destroyed in the contest.

Roësel, who kept some of these insects, observes, tha t

in their mutual conflicts, their manœuvres very much resemble those of hussars fighting with sabres; and sometimes the one cleaves the other through with a single stroke, or severs the head from its body. During these engagements the wings are generally expanded, and when the battle is over, the conqueror devours his antagonist.

Among the Chinese, this quarrelsome disposition in the genus mantis, is converted to a similar entertainment with that afforded by fighting-cocks and quails: for it is to this insect, or one closely allied to it, that we suppose the following passage in Mr. Barrow's account of China to allude:—"They have even extended their enquiries after fighting animals into the insect tribes, and have discovered a species of locust that will attack each other with such ferocity, as seldom to quit their hold without bringing away at the same time a limb of their antagonist. These little creatures are fed and kept apart in bamboo cages; and the custom of making them devour each other is so common, that during the summer months, scarcely a boy is to be seen without his cage of locusts."—Travels in China, p. 159.

The country people also, in many parts of the continent, look upon the *mantis religiosa* as being a divine insect, and would not on any account injure it. Dr. Smith, however, informs us, in his Tour on the Continent, that he received an account of this mantis that seemed to savour little indeed of divinity. A gentleman caught a male and female, and put them together in a glass vessel. The female, which in this, as in most other insects, is the largest, after a while, devoured, first the head and upper parts of her companion, and afterwards all the remainder of the body. Roësel, wishing to observe the gradual progress of these creatures to the winged state, placed the bag containing the eggs in a large glass, which he closed to prevent their escape. From the time they were first hatched, they exhibited marks of a savage disposition. He put different sorts of plants into the glass, but they

refused them, in order to prey upon one another: this determined him to supply them with insect food. He put several ants into the glass to them, but they then betrayed as much cowardice as they had before done of barbarity; for the very instant that the mantes saw the ants, they attempted to escape in every direction: this was evidently an instinctive fear of a natural enemy. He next gave them some of the common house flies, which they seized with eagerness in their fore-claws, and tore in pieces; but notwithstanding their apparent fondness for flies, they continued to destroy each other, through savage wantonness. Despairing at last, from their daily decrease, of rearing any to the winged state, he separated them into small quantities, in different glasses; but here, as before, the strongest of each community destroyed the rest. He afterwards received several pairs of mantes in the winged state: profiting by his former observations, he now separated them, a male and a female together, into different glasses; but they still exhibited signs of a rooted enmity towards each other, which neither age nor sex could mitigate. The instant they came in sight of each other, they threw up their heads, brandished their fore-legs, and each waited the attack. They did not, however, long remain in this posture, for the boldest throwing open his wings with the velocity of lighting, rushed at the other, and often tore it in pieces.

Another species, the *mantis precaria*, is the supposed idol of the Hottentots, which those superstitious people are reported to hold in the highest veneration; the person on whom the adored insect happens to alight, being considered as favoured by the distinction of a celestial visitant, and regarded ever after in the light of a saint. The eyes of the two mantes before mentioned, I dissected, and placed them between two slips of glass, which I send for your inspection. You will find the corneas to be composed of numerous plates, and each plate studded with many thousand lenses, similar to the eyes of the locust. One

of the glass sliders contains portions of a single plate; taken from the upper surface of the cornea; and, notwithstanding the eye had been scratched and defaced, in consequence of its having been thrown loose about the box among shells and other hard substances, yet the figure of each lens is so well preserved, as to show the image of the lamp flame in the most distinct and perfect manner. I must here observe, that when Dr. Wollaston measured the eyes of the insects I had dissected, as described by me in your present volume, p. 71, it was not from a single plate of the cornea, but from all the plates combined, that he selected a single set of lenses, and then measuring the focal length of that combination, he found that the tubes were of a length corresponding with the focus of such combination; and which proved that the tubes were adapted for the purpose of conveying a perfect image of any object, from the lenses in the cornea, to the lens or humour in the retina. I also send you two other glass sliders, between which are placed some large blood-vessels and muscles, taken from the thorax of the two mantes; and in which the distinguishing characters are finely seen.

Within the box, mentioned at the commencement of this letter, I found several species of foreign *cicada*. Some species of these insects, according to Linnæus, are frequently found spread over the country for many miles round. They are excessively voracious, and do infinite damage in their periodical swarmings, both to orchard and forest trees; and were it not for the number and variety of their enemies, and the naturally short duration of their lives, the inhabitants would often suffer from them all the horrors of famine. It seems to have been these insects of which Mr. Hughes says, such vast swarms were either bred, or came into the island of Barbadoes, in the year 1734-5; that they destroyed almost every green and tender plant. So great was the destruction that they caused, especially among the potato vines, on whose roots the

poor people chiefly subsisted, and such was the scarcity of food occasioned by them, particularly in the parish of St. Philip, that a collection was made for these sufferers throughout the rest of the island.

Domestic fowls are fond of them ; and even some of the American squirrels become fat with eating them, at the times when they are very abundant. The Indians also pluck off their wings, and boil the bodies for food. One of those I found in the box I now send for your inspection. Some of the others I dissected, and found the eyes compound ones, similar to those of the locust. I also send you the rostrum or proboscis dissected, and placed between two slips of glass. The three instruments which I found within it, differ from each other, both in shape and the uses to which they are applied by the insect. One of them is perfectly straight, and is used for piercing the plant, in order to extract the juice or sap, as it flows up through the vessels in the plant; this is extracted by means of a pair of lips at the end of the proboscis, which creates a suction like the lips at the end of a flies trunk : the proboscis being tubular, the juice or sap is conveyed through it. Another piercer is curved, like a bent dissecting needle, to pull open any of the vessels in the plant, in order to obtain the sap more readily as it flows up ; or to rip open the body of a caterpillar, which this insect frequently regales upon, after it has wounded it with the third instrument, which, you will perceive, is serrated at the end like the darts in the sting of a bee or wasp. I also send you as an opaque object, the head of one of these insects, with the perfect proboscis, containing within it similar instruments to those above mentioned. I likewise send its *ovipositor* dissected, showing the three very singular parts of which it consists ; it is placed between two slips of glass. Also another *ovipositor* from a similar species of insect, with the three parts combined ; together with the sheath which encloses them, when in a state of rest. This instrument answers the purpose of a double

auger, the sides of which play alternately backwards and forwards, parallel to each other, and thus bore a hole of a regular depth, in very hard substances, to deposit its numerous eggs in, and without their ever being liable to be displaced. You will find this to be a most curious instrument, and it well deserves your very close inspection, the construction of it being so well adapted for the above purpose. The dissected eyes of these cicadæ, are also placed between two slips of glass, consisting of many thousands, and the lenses varying in their shapes; some being hexagonal, and others perfect squares; of this you will be satisfied when you examine them.

With these I also send you one of our British flies, a species of *empis*, for your inspection. The head of it is nearly a perfect sphere or globe, almost the whole surface of which is studded over with eyes, beautifully arranged. You will observe that it has a very long proboscis or trunk, in which are contained four very curious instruments, lying, when in a state of rest, within a groove in the trunk. A set of these instruments I have dissected, and placed them between two slips of glass for your inspection. It is with these instruments that the insects open the bodies of other flies, and suck out their juices. I also send you another fly, a species of *asilus*, whose habits are similar to the above; and it appears to be created for the purpose of making thinnings amongst the numerous species of flies. The instruments contained within the proboscis of this fly, differ very much from those of the *empis*; they are much more powerful, and are capable of doing great execution upon those insects which are subjected to their attacks. I have dissected, and displayed between a glass slider, two sets of the instruments; these, when in a state of rest, fold together like the blades of a knife, and are enclosed within a groove in the trunk of the insect. I have also dissected its compound eyes, which are exceedingly numerous, and the lenses in the corneas vary very much in size. Accompanied with these is also a fly, of the

genus *scatophaga*, whose sustenance is derived from the bodies of other insects; this identical specimen I observed on a pane of glass in the window within the house. Near it was one of the common house-flies, on the back of which it placed itself, and with its two fore-legs forced down its head, and tore open the thorax by means of a powerful and sharp instrument; and having extracted all the juices, left its unfortunate victim dead on the spot. The instrument it used to effect its purpose, appears to be single, and generally lies within a groove in the tongue, but can be thrust out at the will of the insect, and be plunged into the body of any fly it is disposed to make a meal from. Two of these tongues I have dissected in order that you may examine the instruments. You will also observe the curious structure of the muscles in the tongue, many of which are separated for that purpose, and placed between slips of glass; and between which I have also placed dissections of its numerous compound eyes, some curious hooks from the end of its abdomen, together with some of its legs, and the muscular fibres attached to the thighs; and also some curious bundles of muscles, taken from the thorax. You will perceive from the dissections I now send, and those I have already pointed out to your notice in my former letters, that, wonderful as it may appear, insects possess organs very similar, both as regards construction, and the uses to which they are applied, to the instruments we use in many instances in the arts and sciences, and also for the purposes of agriculture and husbandry.

As I am on the subject of dissection, I beg leave to recommend to yourself and your entomological readers, a work on British Entomology, now publishing by Mr. John Curtis, the dissections in which are performed and engraved by himself, and to the correctness of which I can bear testimony, as having myself dissected many similar specimens to those given in his work; and I have the pleasure of observing, that no minutiae in that department

appear to have escaped the eye and hand of this celebrated artist, and entomologist. With the insects in the box, I have already mentioned that there were several specimens of minerals; a few of these were very interesting, both from their characters and their splendid colours. I would recommend to your microscopic readers, to examine the mineral kindom; it is an ample field, and will enable them to enrich their collections of microscopic objects. Indeed, some specimens of minerals vie with, and even exceed in beauty and arrangement, the most splendid insects. But, indeed, let us examine whatever part of nature we may, in every thing formed by the wisdom and power of an Almighty hand, we see

“ The Great First Cause has every where enriched  
His boundless works; not e’en the lowly earth,  
On which we mortals tread so thoughtlessly,  
Is suffered to remain inert, but works  
Its destined task, and silently prepares  
Its treasures vast, of countless minerals;  
Nor least of these, the deep metallic ore,  
Asks and deserves attention, grateful heed.”

I am, dear sir,

Your obliged friend,

To T. GILL, Esq.

THOS. CARPENTER.

### References to the Figures.

In plate IV, fig. 1, is part of the head of a locust, in which its formidable jaws, cutting and grinding teeth, are plainly to be distinguished; as likewise also another pair of smaller jaws and teeth, posited beneath the larger ones, and which seem intended to seize and grasp the herbs, which it afterwards masticates with the latter teeth.

Fig. 2, are the ends of the three instruments, contained within the rostrum of a foreign cicada; one of which is straight and pointed, another is curved or bent, and the third is serrated.

Fig. 3, is the ovipositor of the same insect in its com-

bined state, shown as magnified upon a large scale, and which its curious and beautiful structure is seen; and fig. 4 shows it as separated, but on a smaller scale.

Fig. 5 is the spherical head of the *empis*, a British insect; showing its large compound eyes, and its long proboscis, or trunk; fig. 6, the dissected parts, consisting of a tongue, cleft at its end; a sheath; and four instruments, which are usually lodged in a groove formed in the sheath; one being sharp pointed, another formed like the point of a knife, another blunted at its point, and the fourth cleft at its end, and curiously shaped, as is shown on a larger scale in fig. 7.

Fig. 8, the trunk, and the three instruments usually contained in a groove within it, of an English insect, the *asilus*. These instruments are pointed, sharp on one of their sides, and hairy on the others.

### XXXIII.—*On the Peasants of Neufchatel, in Switzerland.*

By M. ROSSEAU. *With Remarks.* By the EDITOR.

"I REMEMBER in my younger days to have beheld at Neufchatel an object extremely interesting, and perhaps the only one of the kind in the whole world. This was an entire mountain covered with habitations, each forming a centre of the adjacent lands; so that these houses, at distances proportioned to the fortunes of the proprietors, afford the numerous inhabitants of that eminence the tranquillity of retirement, and the sweets of society. These happy peasants live at their ease, free from taxes, imposts, and the oppressions of landlords; they cultivate, with the greatest assiduity, those lands whose products are their own; and employ the hours they can spare from tillage, in a thousand handicraft contrivances, and in making use of that inventive genius with which Nature has blessed them.

"In the winter especially, a season when the deep snows

deprive them of the conveniency of communication, each man shuts himself up with his numerous family, in a neat wooden hut of his own contrivance, where he employs himself in a thousand different exercises, which at once render his solitude pleasing, and improve his health. Neither carpenter, locksmith, glazier, or turner by profession, ever settled in that country; they all work for themselves, none for others; and yet, amongst the great quantity of convenient and elegant furniture with which their apartments are decorated, there is not a single piece that has not been finished with a masterly hand!

“They have also leisure to invent and make a great variety of toys in steel, wood, pasteboard, &c., which they sell to foreigners, and some of these are sent as far as Paris; and amongst the rest those wooden clocks, which have been seen there within these few years. Some they make of metal; and they even carry their ingenuity so far as to make watches: but what seems almost incredible is, that each man performs the different branches, into which the watch-maker’s business is generally divided, and even fabricates the different tools himself!

“Nor is this all—they have useful books, and are tolerably well instructed; they also reason sensibly on most subjects. They make syphons, magnets, spectacles, air-pumps, barometers, and camera-obscuras. Their walls are hung with a multitude of all sorts of instruments. You would take a peasant’s stove for the shop of a mechanic, or the cabinet of some experimental philosopher. They understand something of drawing—they know how to paint, and to calculate. Most of them play upon the flute, and many of them are acquainted with the principles of music, and sing very justly.

“These arts are not taught them by masters, but delivered down to them as it were by tradition. One of those, whom I knew to understand music, told me that he had learned it of his father; another, of his cousin; and some imagined they had learned it without any master. It is

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one of their most frequent amusements to sing quartettos with their wives and children ; and it is amazing to hear in these rustic huts, the strong and nervous harmony of Goudemil, so long forgot by our learned composers.

“ It was equally pleasing to me to wander among these charming villas, and for their inhabitants to show me every mark of the frankest hospitality. But this unfortunately happened when I was young, when my curiosity seemed to be that of a child, and I thought more of amusement than instruction. It is thirty years since, and the few observations I then made are quite obliterated from my memory. This only recurs to my mind, that I incessantly admired in those extraordinary people, a mixture of art and simplicity, which seems almost incompatible, and such as I never observed in any other place. But this is all the idea I have retained of their manners, their society, or their characters.”

*Remarks.* By the EDITOR.

In later times, Neufchatel has given birth to some of the most ingenious mechanics which have ever appeared in this country. The late *Jaques Droz*, who was employed in the construction of the various mechanical parts of Cox's museum, was a native of this place ; so also was *Maillardet*, the ingenious constructor of the beautiful and exquisite pieces of mechanism exhibited in Spring-gardens a few years since. To the same neighbourhood we are likewise indebted for the invention of the musical snuff-boxes and seals, wherein so much science and mechanical skill are displayed ; and indeed the city of Geneva itself owes much of its celebrity to the skill and dexterity of the natives of Neufchatel, whose works are sent to us through that channel.

XXXIV.—*On the Singularly Contradictory Habits of Dutchmen\**.

"THE Dutchman, living in continual danger of inundation, and of losing not only the fruits of his industry but his life, becomes habitually provident. His foresight is admirable, his perseverance not to be conquered, and his labours, unless seen, not to be believed. They astonish us the more, when the phlegm of his temper and the slowness of his habits are considered. View the minuteness of his economy, the solicitude of his precaution, and the inflexibility of his methodical prudence! Who would not pronounce him incapable of great enterprize? He builds himself a dwelling—it is a hut in size, it is a palace in neatness. It is necessarily situated among damps, upon a flat, and perhaps behind the bank of a stagnant canal; yet he marks upon it *my goeneye*, "my delight;" *landluft*, "country pleasures;" *landfigt*, "country prospect;" or some inscription that might characterize the vale of Tempé, or the garden of Eden. He cuts his trees into fantastic forms, hangs his awning round with small bells, and decorates his sunday jacket with dozens of little buttons. Too provident to waste his sweets, he cunningly puts a bit of sugar-candy in his mouth, and drinks his tea as it melts; one morsel serves let him drink as long as he pleases. Around him is every token of care, caution, and cleanliness; but none in his domestic habits of magnificence or grandeur of design.

"Having well considered these his private propensities, the eye turns with amazement on his public works. The country, which Nature appears to have doomed to stagnant waters and everlasting agues; his laborious arm has undertaken to drain, has overspread with verdure, and has covered with habitations. The very element which seemed to bid him utter defiance he has subdued, and rendered his

\* From Holcraft's Travels.

most useful slave; on which, with economical facility, he transports the manifold products of his industry, and the rich speculations of his calculating spirit. Like him other nations have braved the seas; but he alone has every where barricaded them, and prescribed their limit. Fable relates the fictitious labours of Hercules. The vast and endless embankments that guard the coasts of Holland are not fabulous, they are visible! No profusion of words, no skill of language can do justice to the wonders the Dutchman has performed.

“Neatness in Holland is every where to be met with; but taste, I will not say nowhere, though certainly it is a very scarce quality. The people delight in trees, cut into the shapes of animals; in traverse brick work, the bricks accurately laid; in their doors and shutters, nay even their churns and milk-pails being painted green; and in chimneys with weathercocks capped in the same taste. A Dutchman always wishes to know which way the wind blows; for he is often either a miller, waterman, or merchant.

“Between Delft and Rotterdam there is a great number of saw-mills. An observation had forced itself upon me soon after I entered the United Provinces. The country abounds with water, and the Dutch neglect no opportunity of profiting of the gifts of Nature; yet I do not recollect to have seen a single water-mill. The reason was before us: there were innumerable canals, but no streams; it was almost a level surface. In the winter vast tracts of the country are overflowed, and some of the mills are employed to drain the lands. The Dutch are remarked for the great simplicity, as well as the benefit of their mechanical contrivances. A friend who has pursued such studies, informed me, that thoughts of the highest utility had more than once been suggested to him by the mechanism of Dutch toys.

“Proofs of national sagacity are continual: half a life perhaps might be usefully spent in collecting and pub-

lishing them. The land is low, and a wind-mill is the better for being high. The Dutchman therefore builds his house first, usually in the form of a truncated cone, and then erects his wind-mill upon his house. This is rather more rational than the mode in Westphalia, Holstein, and many other parts of Germany, of erecting one building for house, cow-house, barn, stable, and pig-stye.

"In the environs of Lisle are remarked the numerous wind-wills, amounting as I have read to one hundred, and which are employed for the manufacture of oil. This has been a great branch of trade."

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**XXXV.—***On the Mode of Cleaning Harbours in Holland; and the Dutch Sluices and Mills \*.*

IN the harbour of Dunkirk, the water is sometimes so high, that they are obliged to use ladders to ascend from the wharf into a ship of a hundred tons burthen, and this at low water; and perhaps the next day it will be so low, that they are obliged to use the same ladders to descend from the wharf into the vessel. This effect may appear strange, but the cause of it is still stranger; which is this: In all dry summers the haven is very subject to be silted up, by the sea bearing its foul waters into it, owing to the many shelves of sand upon that coast; so that the ordinary force of a small river coming from Bergue is not able to carry out what the sea lodges in the haven; but, by dint of reason and industry, the work is managed thus:—When the haven is silted up to a certain height, the town causes the water in the aforesaid river to be kept up by their sluices for eight or ten days together. They then order the ships and other vessels in the haven to ride in the midst of it, as close to each other as they can; and being

\* From "A design for Draining the great level of the Fens, called the Bedford Level." By Col. William Dodson, 1665.

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thus placed, they at low water open their sluices, and give liberty to the penned up water from Bergue to run through the haven, so that it *grinds* the bottom, through the intervals left between the ships, and carries away all the silt and sand out of the haven, whilst the ships rock to and fro, as if they would fall upon each other; and by this means the haven becomes deep again.

The same mode is also practised at Delft haven, where the river which comes from Overkey answers the same purpose, and were it not for these rivers there could be no havens there; but as the sluices which cast their indraughts into them stand at their very entrances, they thus grind the bottoms clear, and effect these great works.

*On the Dutch sluices and mills.*—North Holland, upon the Zuyder Zee, has sluices, which run at Saardam, Monkenenden, Horn, Ancusen, and Middle-bleak; and as they have not above a quarter of the tide's ebb to run at, they force their waters into the leading rivers by costly wind-mills.

Much of the richest ground, where they make their best cheese, is under low-water mark at sea, at least six or seven feet; as the Bempster, the Skermer, the Wart, &c. These are all drained by a multitude of wind-wills, either vertical or horizontal, each mill cost, in the year 1665, near six hundred pounds sterling, and there are no less than four at Skermer, one standing four feet higher than another, and thus raising the water from one to another, until it is brought sixteen feet high, when it runs into the drains which lead it to the sea.

Friezeland and Gronning, from Campen in Guelderland, to Dam in Gronning, is all drained by *sosses* and sluices to sea-ward. The length of these three provinces is no less than an hundred and twenty miles along the sea-coast, and yet they have no rivers which run from them into the sea. Nor do they admit the sea to flow into any of their provinces, but keep it out by sluices and *sosses*, so far as art and cost can promise them security.

In Friezeland, which is a large province, the grounds lie all the winter very deep in water, frozen over with ice and snow; this they suffer, in order to keep the ground warm, and by this means preserve the roots of their grass from perishing by the frost. In February and March, when the winter is breaking up, they run all the water into the sea by their sluices, which continue running violently for a month or longer; they being their only passages for voiding such great quantities of water.

In North and South Holland they perform the same work with their wind-wills, which are kept constantly working the latter part of the winter.

*Remarks. By the EDITOR.*

These Dutch wind-mills are not, as might be supposed, employed to actuate pumps to raise the water, but what are termed *lifting-wheels*; these are similar to under-shut water-wheels, and like them are furnished with flutter-boards instead of buckets. These wheels are indeed used in the reverse manner of water-wheels, as instead of being driven by the water, they, actuated by the power of the wind-mills, drive or raise up the water before them four feet to the next higher level or pond; they being enclosed in front, in a circular sweep or race, exactly similar to that of a water-wheel, into which race the water from the lower pond flows, in order to be raised by the action of the wheel into the next higher pond, and so on through the three succeeding ones, as described in the foregoing article; until having finally attained the height of sixteen feet, it is thrown into the sea, over the top of the embankment.

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XXXVI.—*On the Manufacture of Parmesan Cheese* \*.

ON the 14th of April, I went to see a large cheese dairy, three miles from Milan, one of the dairies at which that

\* From Cadell's Journey in Carniola, Italy, and France.

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kind of cheese, called in commerce Parmesan, is made. It is called in Italy *formaggio di grana*, because it is commonly used in a granular form, being grated; and brought to table to be eaten with soup. Much of this cheese is also made near Lodi and Parma.

The word *formaggio* is from *formaticum*, which signifies, in the Latin of the middle ages, cheese prepared in a form. The cheese is made in the morning before sunrise.

*The vessel for heating the milk.*—The morning's milk, and that of the preceding evening, are put into a large brass vessel, five feet in height, narrow at the bottom, and widening out like a trumpet, to three feet diameter at top. This vessel is placed over a fire, which is sunk in the ground; and the vessel can be removed from over the fire by a crane. When the milk is heated, runnet, in the form of paste, is put in, and a little saffron to give the cheese the yellow colour. When the coagulation has taken place, the vessel is taken off the fire, the curd is taken out in a cloth, and put within a broad hoop, the sides of which are as high as the cheese is intended to be. This hoop can be narrowed by means of a rope tied around it. A board is placed on the top of the cheese, and a small weight upon the board. The cheese is not put into a press.

*The salting of the cheese.*—After this the cheese is taken to the salting-room, and two cheeses are placed together, one above the other, with broad hoops tightened around them. Much salt is laid upon the top of the uppermost cheese; the salt dissolves, and the brine filters through the cheeses. The cheeses are shifted from one place to another all along the benches of the salting-room, and are beaten with a flat piece of wood, cut with straight lined furrows intersecting each other. The cheese is next taken to the magazine, where each cheese is placed on a shelf.

The sides of the cheeses are painted with a mixture of litmus, otherwise called tournesol and oil, to give them a

purple colour. The tournesol is a plant collected in the south of France.

The cheeses are set upon the shelves in the order in which they are made, and the cheeses of each month are placed together. Those of the months of October and of May are the best, and bear the highest prices. The best cheeses can be kept longest, and are improved by keeping for some years. There was an October cheese which had been kept five years, and was to be sent to the emperor.

After the great cheeses are made, the liquid in the brass vessel is again heated over the fire, and curd is collected from it, to make the small cheeses, called *mascarla*.

The number of cows kept for making cheese in this dairy is eighty. They are always kept in the house in winter, and at this season of the year. They are fed upon grass all the year, except, perhaps, in December. The house in which they are kept is not above nine feet high to the ceiling. They are not kept very clean. In summer they go out into the fields to feed during the day.

The cows are of a dark colour, and are brought from Switzerland, which is found more profitable than rearing them in this country: the bull is also Swiss, and fourteen years old.

It is estimated that 2,000 head of cattle pass the Mount Saint Gotthard every year, coming from Switzerland into Italy. Considerable fairs for the sale of Swiss cattle are held at Lugano.

The evening's milk is put into flat copper vessels, three feet in diameter, in order to collect the cream.

There is an ice-house in the dairy for the purpose of applying ice for cooling the cream which is put into the churn. This they find facilitates the making of butter at certain seasons of the year.

**XXXVII.—*On the construction of the Russian Stoves, their advantages, and the manner of closing their Casements.* By M. HENRI FAVRE\*.**

THE author, in this memoir, objects to the construction of the stoves and chimnies used in Germany, Switzerland, and part of France; a construction which not only requires large quantities of combustibles to be employed, but also very inadequately fulfils their object.

In Russia, on the contrary, every thing is calculated to prevent the external air from penetrating into the apartments; the entrance-porch, the staircase, the hall, the floors and ceilings, the double windows, the placing of their stoves, all concur to maintain a temperature favorable to health.

The external forms of their stoves, either triangular or square, offer nothing remarkable; but they may, nevertheless, like our stoves, receive every embellishment which luxury and fancy may dictate; but their interiors present real advantages, in those dispositions which it is essential to adopt, in order to give them that remarkable superiority over our heating apparatus.

The fire-place, which may hold from eight to twelve billets, from two to two and a half feet long, and weighing from thirty to thirty-five pounds, receives immediately the full force of the flame; and the wood which is kept better collected together, than in our stoves, affords more quickly a high degree of heat.

Six or eight earthenware pipes, accordingly as the shape of the stove may be triangular or square, fills up the space which exists above the fire-place. These pipes rise perpendicularly from the bottom of the furnace to its top; they are united together in such a manner, that a section of their plan would appear in the form of a grate, but varying in its shape, according to the nature of the triangle

\* From Ferussac's *Bulletin Technologique*.

or parallelepipedon. They communicate by means of openings made in curved pipes, placed alternately above and below at their points of separation, and these curved pipes adding to their length, thus form a channel of forty or fifty feet long, through which the flame and heated air pass, and deposit all the caloric with which they were charged; excepting that which is indispensable to the procuring of their escape up the chimney. The first of these pipes communicates with the fire-place, by means of an opening made in its arch; and the last, which receives at its upper end, the smoke after it has passed through all the others, delivers it at its lower orifice into a channel, which conducts it into the chimney by the side of the stove. The fire-place is closed by means of a cover, formed of three separate parts, the one being a square plate pierced with a hole, of from five to eight inches in diameter, according to the size of the stove; this opening is furnished with a rim or border which projects an inch and a half, and receives within it a circular cover, furnished with a handle, and which cover is exactly fitted into the opening; the third part, lastly, is in a form of a bell, which again covers, and surrounds the whole, it being fitted upon the outside of the projecting rim or border: this bell might at first sight appear to be superfluous, but it is of the greatest use, in exactly closing the opening by means of the thick mass of air which it contains within it; and which, being a bad conductor of heat, hinders it from escaping so rapidly as it otherwise would do.

All the parts of this cover are made of cast-iron, and are about a quarter of an inch thick. Baked clay would not be so convenient, as it would suffer the heat to pass through it too easily, and be also liable to break.

By means of this interior apparatus, a Russian stove with six pipes will heat, with from thirty to thirty-five pounds of wood, a volume of air equal to 5,760 cubic feet, or a hall of twenty-four feet in length, ten feet in width,

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and twelve feet high. With eight pipes, and the consumption of from thirty-five to forty pounds of wood, it heats two chambers of 5,000, and 7,000 cubic feet. This heating lasts twenty-four hours, and causes the thermometer to rise to  $15^{\circ}$ , the external temperature being from  $16$  to  $20^{\circ}$  below zero.

The wood being perfectly dry, they put at once, into the fire-place of the stove, the whole quantity destined to be employed ; when this is nearly consumed, and its embers only yield a blueish vapour, they combine, and place the covers upon the opening above-mentioned. If they would, at night, re-animate the heat of the stove, they open the covers of its door for a moment, and throw a pinch of salt upon the embers, after stirring them up, and then quickly close all the openings.

The pipes never need be swept ; the entrance to them from the arch of the fire-place should, however, be examined and cleaned every year, upon the approach of winter. The chimney, which is generally from nine to ten inches square, must be swept with a brush, to which a cannon-ball is attached, and which are introduced into the chimney by means of a rope, which reaches from the top to the bottom of it.

An addition to these powerful means of heating the interior of their houses, the double casements, which are in general use, in all the habitations of the Russians, rich and poor, also contribute to maintain, throughout, a temperature sufficiently mild.

In order to this, they fix within the walls a double frame, of from eight to ten inches in breadth, and four inches thick ; this frame is intended to receive the casements both for summer and winter, and is generally constructed with the house itself. The double windows in Russia generally consist of two frames or sashes, separated from each other by a space of at least eight inches. At the end of September they prepare to close exactly their summer windows, and they place between the two frames,

upon the flat bottom of the window-frame, a thick layer of very fine sand, this they cover with bricks set in mortar containing salt; they likewise close with tow all the interstices, and glue or paste a thick and strong paper over all the joints of the frames.

This operation, which forms an epoch in Russia, should be performed when the windows are perfectly dry, as the chamber must not be heated during the time of doing it. Without taking this precaution, the glass would be covered with hoar-frost, which would remain during every change of temperature: the salt above-mentioned, serves to attract humidity in the mortar, when the temporary wall is to be removed again.

The current established in heating, by means of the stoves, is sufficiently strong to cause the air in the apartments to be perpetually renewed. The entrance to the hall in the Russian mansions, is generally provided with double doors, furnished with counter-poises, and having between them a space sufficiently large to allow of one door closing before the other is opened. The manner in which the beams and rafters of the floors of their houses are placed, differ in some respects from ours; they first spread a thick layer of clay upon the surface of the earth, which they cover over with sifted rubbish, and sometimes these layers of earth are also again covered over with bands of felt, prepared for this use; the ceilings of their upper rooms are also sufficiently closed.

We thus see, that by taking these precautions, a perfection is attained in the means of defending themselves from cold in the north of Europe; and they enjoy an equality of temperature in their houses, of which the inhabitants of the southern parts can form no adequate idea.

XXXVIII.—On Mr. LEIGH PHILLIPS's mode of Heating Warehouses, &c.; and his Balista Door-Spring.

It is now upwards of twenty years since the Editor was shown this simple and effectual mode of applying heat by Mr. Phillips, in warming the four stories of a cotton factory or warehouse, belonging to his firm, in Manchester.

A *cockle*, or cast-iron oven-shaped stove or fire-place, was erected on the ground-floor of the warehouse, and heated red-hot, in the usual manner; but instead of suffering the heat to escape up the chimney at once, the upper end of the flue, near the roof, was arched and turned downwards again, parallel to the first flue; and this second flue was again curved or arched at the bottom, and again carried up perpendicularly, by the side of the two others, and thus forming three flues side by side, and constituting a mass of brick-work, which when once heated, continued to give out its heat for a considerable length of time. The last flue finally passed through the roof, and finished in a chimney; it being also furnished with a sliding register-plate, near to the roof of the uppermost story of the building, in order to regulate the draught of the furnace. Mr. Phillips was highly gratified with the performance of his stove; and, indeed, we think it well deserves to be imitated by all persons who have occasion to heat similar premises.

*Mr. Leigh Phillips's balista door-spring.*—He took the precaution of causing all the doors of his premises to shut of their own accord, in order to hinder the cold air from entering, and thus counteracting the effect of his heating apparatus, by applying to each door a very simple spring of his contrivance, and which he termed his *balista spring*, from it being formed in a somewhat similar manner to the ancient Roman warlike machine of that name.

This spring consisted of a piece of rope tied together at

its ends, and forming a coil, which was secured above and below by being passed through two staples driven into the door-frame, behind the door; the four parts of the rope received within them, at their middle part, a square piece of wood, two inches thick, and four inches long, tapered away towards its ends, and having four grooves made along its edges at each end of it, for the ropes to lodge in. A mortise-hole was also made through the middle of the block, in which one end of a flat bar of wood could be placed, after the ropes had been twisted together, by turning the block round within them; and the other, or longer end of the wooden bar, then acted against the door by the untwisting of the ropes, so as to close it exactly in a similar manner to the usual door-springs. These cheap substitutes for the ordinary door-springs, had long continued in use, and most completely answered their purpose.

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XXXIX.—*On a Calico-Printers' Drying Stove, at Manchester.*

THE Editor was likewise shown this stove at the above-mentioned time. It was heated by means of a red-hot cast-iron cockle, placed in the middle of its ground-floor; but its other floors consisted of flat *reticulated* arches of brick-work, through the apertures in which the heat circulated through the whole building. He was almost afraid at first sight, to step upon this seemingly insecure species of floor, but was afterwards convinced that his fears were without any proper foundation, and that the floors were abundantly strong for their required purpose. The rows of arches abutted against upright plates of cast-iron, with projecting ledges underneath them, on each side, upon which the bricks were also lodged; and these iron plates were supported upon cast-iron pillars, the whole being thus also rendered completely fire-proof. The in-

terstices were formed by the bricks not touching each other *endways*, although they had a sufficient bearing against each other *sideways*, to ensure their firmness and stability. It must have been a bold undertaking on the part of the architect who first constructed such a floor !

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XL.—*On a Cheap and Simple Crane.*

THE Editor likewise saw this crane in a cotton warehouse several stories high, at Manchester, at the same time as when he saw the preceding articles. It consisted of what is termed a rag-wheel, or a wooden wheel of six feet in diameter, around the rim of which were driven, at equal distances, a number of pieces of iron, made in the form of the letter *x*, and around and between the forks of which pieces of iron an endless rope or cable was passed, that descended from the uppermost room, where the crane was fixed, through all the other rooms to the ground floor, so as to be accessible in them all, and thus to raise or lower any goods, by means of a rope or chain, which was wound upon a smaller barrel, affixed upon the same axis with the great wheel, and to which rope or chain the goods were hung. A similar rag-wheel is also made considerable use of, in raising or lowering the various machines employed in the scenery, &c. of theatres ; and it is highly deserving of being employed in many other cases. ▽

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XLI.—*On the Art of Performing Mosaic Works* \*.

*On the preparation of the enamel.*—The enamel, consisting of glass, mixed with metallic colouring matters, is heated for eight days in a glass-house, each colour in a se-

\* From "A Journey in Carniola, Italy, and France." By W. A. Cadell, Esq.

-parate pot. The melted enamel is taken out with an iron spoon, and poured upon a polished marble slab, placed horizontally; and another flat marble slab is laid upon the surface of the melted enamel, so that the enamel cools into the form of a round cake, of the thickness of three-tenths of an English inch.

In order to divide the cake into smaller pieces, the cake is placed upon a sharp steel anvil, called *tagliulo*, which has its edge uppermost, and a stroke of an edged hammer is given upon the upper surface of the cake; the cake is thus divided into long parallelopipeds, or prisms, of three-tenths of an inch square; and these parallelopipeds are again divided across their length by the *tagliula* and hammer, into pieces of the length of eight-tenths of an inch, to be used in the mosaic pictures. Sometimes the cakes are made thicker, and the pieces smaller.

For some pictures, the enamel, whilst fused, is drawn into long parallelopipeds, or quadrangular sticks, and these are divided across by the *tagliulo* and hammer, or by a file; sometimes also these pieces are divided by a saw without teeth, consisting of a copper blade, and emery; and the pieces are sometimes polished on a horizontal wheel of lead, with emery.

Gilded mosaic is formed by applying the gold upon the hot surface of a brown enamel, immediately after the enamel is taken from the furnace; the whole is put into the furnace again for a short time, and when it is taken out, the gold is firmly fixed in the surface. In the gilded enamel used in mosaic at Rome, there is a thin coat of transparent glass laid over the gold.

*On the ancient enamel.*—The ancient Romans, besides the enamel for mosaic, made other works in enamel. Winkelmann mentions ancient tiles, of a kind of glass, or enamel, for paving the floors of rooms; and he describes a small picture, composed of filaments of enamel, of different colours, agglutinated by fusion, and each transverse section of

this gave a picture like that at the extremity \*. The antique pastes, or artificial gems, are also the products of an art allied to enamel.

Some of the ancient mosaics are said to be formed of coloured stones, but the greater number are composed of pieces of enamel.

The mauufactory of Mosaic pictures at Rome, belonging to the Pope, is in a large building to the south of St. Peter's. The building contains a collection of enamels, drawn out into the form of sticks. These are arranged according to their colours, in an extensive suit of rooms. The number of shades of colour is 17,000 !

The enamel is very fusible, so that the small sticks can be melted, and drawn out into a finer size, at the flame of a candle, without the assistance of a blow-pipe.

Mosaic pictures of a moderate size are imbedded in a case of copper, which has projecting crooked pieces of copper soldered to the bottom of it, in order to fasten the paste or mastic in which the pieces of enamel are stuck.

Large pieces are imbedded on a slab of stone, or affixed upon the surface of a wall. Anciently, the paste in which the pieces of mosaic were imbedded, called in Italy stuccó, was composed of one measure of quick-lime quenched in water, and three measures of pounded marble ; these were made into a mass with water and white of egg, and this was called marmoratum ; but this paste hardens too rapidly, so that it is hard before the workman has time to insert the pieces ; and it is injured by damp more readily than the cement made with oil.

The paste now used is composed of one measure of quenched quick-lime, and three measures of powdered travertine stone ; these are mixed with linseed oil, and are stirred and worked up every day with a trowel. The mass is at first level on the surface, but afterwards swells

\* Winkelmann. *Hist. de l'Art. Livre 1, chapitre iii.* We have seen compound rods of enamel thus formed, and small pictures of various sizes, according to the degree of thinness to which the rods had been drawn out. EDITOR.

ap. Each day some oil is added, to prevent the mass from becoming dry and untractable. The mass is ready in a shorter time in warm weather than in cold; in summer the mass is at its perfection in twenty days; this is known from its ceasing to swell, the water that was in the lime having evaporated; the mass is then uniform throughout, like an ointment. In winter, and when the air is moist, it requires a month to bring the paste to perfection.

The wall on which the mosaic is to be applied must have the lime taken off its surface; then furrows, an inch deep, are formed in the wall to fix the cement.

For the same purpose also, large-headed nails are driven into the joints in the wall, and wire is drawn from one nail to another. After this, the wall thus prepared is painted over with linseed oil. Then the cement is laid on to the extent of as many palms as can be executed before the cement dries. The plasticity and softness of the cement lasts about twenty days; after that the oil exudes, and the lime and travertine becomes a hard mass. The cement made with linseed oil is yellow, that made with white of egg is white, and the white cement is considered to be a character for distinguishing the old mosaic from the modern; but some of the modern is also made with white cement.

The pieces of enamel are taken hold of with a forceps, in order to insert them into the cement.

The French government, during their dominion in Milan, employed Giacomo Raffaelli, an artist of the Roman school of mosaic, to make a copy of the picture of the Last Supper, by Leonardo da Vinci, which is in the dining-hall of the suppressed monastery of Santa Maria delle Grazie, and occupies one end of the hall, of the same size as the original; namely, about twenty-four feet by twelve.

This mosaic, one of the largest that has appeared, is imbedded upon twelve slabs of marble, from the lake of Maggiore; these twelve pieces were placed together on tressels in the work-shop, in a horizontal position, so that

it was necessary to view the picture from an elevated gallery. It occupied the labour of eight or ten men daily, during eight years, from the commencement to its completion, and cost £7,500 sterling.

After the bits of enamel are fixed into the paste, and the whole is allowed to dry for two months, the surface is brought to a plane, and polished, by means of a flat stone and emery. A lapidary's wheel and emery is also used for polishing the surface of individual bits before their insertion. After the surface of the picture is polished, the interstices between the pieces of enamel are filled up with a paste of the same colour with the adjacent pieces.

Rome is the principal, or rather the only school of mosaic painting at this day in Europe. And besides the great establishment, there are many artists who work in mosaic there; and a variety of small mosaic pictures are made for ornamenting rings, snuff-boxes, and other toys.

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#### XLII.—*On the Nitrates* \*.

THESE salts result from the combination of the nitric acid with the different bases. They are the more important, not only on account of the great number of useful kinds which they include, but more particularly on account of the immense consumption which is made of one of the species, the *nitrate of potash*, or salt-petre; which not only enters into the composition of gun-powder, but the nitric acid is procured from it, and which is one of the principal agents employed in a great number of different arts. We see then, that it is this species of salt which should peculiarly fix our attention; and it deserves to be studied with the greater care, as it will serve to make known the history of all the other kinds. Nevertheless, as we propose to treat upon all these salts which are employed in the arts, and in

\*.From the *Dictionnaire Technologique*.

medicine, before we proceed to describe the species, we shall indicate the characteristic properties of the nitrates.

All the nitrates are soluble in water, and it is truly unfortunate that there is no exception in this respect, as it renders the determination of the different kinds exceedingly difficult. They all likewise possess the property of fusing when thrown upon burning coals; but this character does not belong to them exclusively, as they resemble the chlorates and the iodates in this respect; nevertheless, when it becomes necessary to distinguish between the three kinds, it is easy to do it by means of the sulphuric acid; which, when it is brought into contact with a nitrate, causes the separation of an acid that exhales in the atmosphere in the form of white vapours; whereas, when an iodate is treated in the same manner, it yields violet fumes; and the re-action of a chlorate is such, that there results from the mixture a vivid deflagration. Finally, if we also wish for another means of rendering still more sensible the differences which exist between the nitrates and these other two species of salts, if we add to a supposed nitrate a little of the filings of iron or tin, and then pour upon them a little sulphuric acid, the vapours produced in this case are no longer white, but on the contrary are reddish; because the nitric acid, instantly that it is set free, re-acts upon the metal it is in contact with, and hence results the production of the nitrous vapours.

We profit by the action of the sulphuric acid upon the nitrates, in order to extract the nitric acid; and it is by this process that we now procure all that is sold in commerce.

The facile decomposition of the acid in the nitrates renders them most energetic agents, and hence their use is most valuable and frequent in the cleansing the surfaces of various metals, and in oxidizing and dissolving them; and indeed there are but few metals which resist their action. It is also from this property, possessed by all the nitrates, that their general utility is derived, as they always act so

as to cause the oxidation of any combustible substance when we employ them for this purpose. Such is the motive for using them in the manufacture of gunpowder, in the refining of certain metals, in the oxidation of others, &c.

There is also another general property of these nitrates, of which we avail ourselves, and that is the result of the action of heat upon these salts. Thus their bases are fixed and decomposed by this means, with more or less difficulty indeed; but, by perseverance, we can always finally obtain the base, sometimes in the state of an oxide, and sometimes in its radical state, according to the affinity of the base for oxygen. It is only to this process that we can have recourse, in order to procure barytes, strontian, and some other bases in a state of purity.

Amongst all the nitrates known, there is only one which contains an excess of acid, all the others being perfectly neutral. The composition of these is such, that the acid contains five times more oxygen than the bases.

*Nitrate of Silver.*—This salt is obtained by dissolving one part of fine cupelled silver, in two parts of the pure nitric acid. The whole must be put into a matrass, and be exposed to a slight degree of heat on a sand-bath; the re-action is sudden, one part of the acid is decomposed, the oxidized metal is dissolved, and this solution is accompanied with a vivid effervescence of the deutoxide of azote, which, when it comes into contact with the air, is transformed into red nitrous vapours.

If the silver is pure, and the re-action, as we have above said is rapid, the solution obtained is colourless. But if the silver contains copper, it is tinged with a blue colour, which is more or less intense, as the alloy is the more considerable. It is proper to state, nevertheless, that a tint of blue-verditer is sometimes manifested, which is not owing to the presence of copper, but is entirely caused by the solution of a certain quantity of nitrous gas in the liquid nitrate of silver; a phenomenon, which we must

suppose in this case to have been caused by a slow reaction, produced without the employment of heat.

When the silver contains gold, which often happens, it falls to the bottom of the liquid, in the form of a finely divided blackish powder, which can be readily separated by mere decantation; it must then be put into a conical glass vessel, be repeatedly washed with distilled water, and be submitted to the action of a slight degree of heat: the gold, on being collected, will then resume its natural colour.

We have already mentioned that the pure nitric acid should be employed in this process, as that of commerce usually contains muriatic acid, which precipitates a part of the silver in the state of an insoluble chlorate; we may, indeed, reduce the silver, but it needlessly complicates the operation, and diminishes the result.

It is not, indeed, so absolutely necessary to employ cupelled silver, in order to obtain a pure nitrate of silver; only that it renders the operation more speedy, and more easily performed. We may use silver coin, or part of a silver vessel for the purpose, but then we must take the precaution of crystallizing the nitrate of silver, which by this means we can readily separate from the nitrate of copper, by reason of the greater degree of solubility which the latter salt possesses. We wash the drained crystals with a little distilled water, and which we finally add to the other mother-waters; we then concentrate the solution, and crystallize it anew, and repeat the process until the copper begins to predominate, which we perceive by the intensity of the blue colour. When we have arrived at this point, we dilute the mother-waters with a certain quantity of water, and plunge into them clean plates of copper; the silver will then precipitate under the form of a granular and brilliant powder. When the action ceases, you separate the liquid, and carefully wash the precipitate; this you must dissolve in a fresh quantity of nitric acid, in order to convert it into the nitrate of silver.

It is well to remark, that an excess of nitric acid greatly promotes the crystallization of the nitrate of silver; and that when it so happens that a solution of silver, sufficiently concentrated, will not crystallize, we may make it form a mass by adding the nitric acid to it.

We may also separate the greater part of the copper, by evaporating the first solution to dryness, and slightly liquefying the dried mass: nearly all the nitrate of copper is decomposed by the action of the heat, although the nitrate of silver experiences no sensible alteration. We then add water to dissolve the nitrate of silver; suffer the oxide of copper to deposit itself, decant the solution, and evaporate it anew.

It is easy to detect the presence of copper in the solution of silver, by means of ammonia; which, when poured in a slight excess into the solution, communicates a blue tint to it, the more evident, according to the quantity of copper it contains.

We employ the nitrate of silver under two different forms, viz., either in the state of crystals which are obtained in the manner above described; these are in the forms of large rhomboidal or hexahedral plates, which are more translucent than transparent, being of a blueish white colour, and having a very disagreeable styptic and metallic taste, or else in the shape of cylinders (the *lapis infernalis*), the crystals being melted by heat, and poured into a mould in the manner we shall now indicate:—

When we have obtained the pure nitrate of silver, we dry it completely in a porcelain capsule; we then transfer it into a crucible, formed either of silver or platina, and heat it in order to liquefy the nitrate of silver. Whilst the fusion is effecting we prepare the mould ready to receive the fused crystals; this mould may be formed either of brass or iron. It consists of two flat plates, in each of which are cut a series of parallel semi-cylindrical channels, which serve to form the halves of the cylinders. These channels in the two plates exactly correspond with each

other, so as to form, when closed, a row of hollow cylinders, shut at their lower ends, but their upper ones open, and communicating by means of a common channel, which is formed in the upper ends of the plates. The two plates, when placed in contact, are firmly retained in that situation by means of an iron frame, and two binding-screws. Both of the plates must be made perfectly clean, and be slightly heated, in order to drive off all humidity; but the inside of each channel should be rubbed over with an oily linen cloth, so as to leave but very little oil, however, remaining in the channels, in order to avoid the forming of any black spots upon the surfaces of the cylinders, which would oblige us to return them again to the crucible, and might thus effect the reduction of the silver.

If we pour the nitrate into the moulds as soon as it is fused, it will have a pearly-gray colour; if we make it for sale, we shall be obliged to keep it for some time in fusion, in order to give it a little more colour; but, in order to prevent the decomposition of a small quantity of the nitrate of silver, we must add a relative proportion of the oxide to it.

This colour, which the consumers require to be given to the fused nitrate, is not, however, to be considered as mere caprice, as it is certain that the gray *lapis infernalis* is not of a sufficient consistence, it breaks too readily; but after it has been longer heated, and become blacker, it possesses more hardness.

Otherwise, when we have attained the desired point of fusion, and placed the mould in the position above described, we pour the fused nitrate into it; and when we judge that it is become fixed, we loosen the binding screws, remove the frame, and separate the two plates by gently striking them, taking the precaution of holding them in the right hand. We then place the plates upon a sheet of paper, and remove the fused cylinders by means

of the point of a knife, which we apply to that part of the mould where the common channel is formed. But when the cylinders, which we can generally remove by this means, will not quit the mould, we must remove them one by one, and also detach the adhering scraps with the edge of the knife; we also remove from the moulds all the bits which are too small for sale, but we carefully remove those which have entirely filled the channels, and before the mould has become too cold.

These cylinders have this serious inconvenience attached to them, that when made use of by the surgeon, they are afterwards liable to retain upon them a little of the *pus* or *virus* derived from the places or wounds upon which they have been applied, and thus to inoculate other persons therewith, upon whom they may be afterwards used. We must take care that the cylinders of the *lapis infernalis* be packed in long and narrow boxes; and generally fill up the interstices between them with the grains of linseed, after which they will bear carriage without danger of breaking.

With the cupidity which enters into those professions which are practised in secret, we find some persons who are dishonest enough to speculate upon making fraudulent imitations of the *lapis infernalis*. Now the price of this preparation being high, it has become amongst these people, one of their principal objects of fraud. It is often made of silver alloyed with copper, and which they do not separate; but in order that the *lapis infernalis* may not be of a verditer tint, they keep it a long time in fusion, but not long enough to effect the complete decomposition of the nitrate one of copper; and thus it follows, that the oxide of copper becomes mixed with the nitrates, and gives the *lapis infernalis* a blackish tint. By dissolving these mixed and fused nitrates of silver and copper in a sufficient quantity of distilled water, filtering the solution, and pouring upon the residuum a little nitric acid, we instantly detect

the presence of the copper, from the blue colour of the solution, and which may be rendered still more evident by adding ammonia to excess.

Another fraud, equally mischievous, is also continually practised; this consists in adding to the nitrate of silver, nitrate of potash. These are fused together; but it is easy to detect this fraud, as the *lapis infernalis*, when it is pure, or only contains a little copper, affords a crystalline and radiated fracture; but that which has been alloyed with the nitrate of potash, has a smooth and homogenous fracture. If we would, however, acquire a more certain proof of this fact, we have only to dissolve a determinate weight of the suspected nitrate, and precipitate the silver by means of the muriatic acid, added in a slight excess; we then filter the liquid, evaporate it to dryness, and we shall obtain in the residue, the nitrate of potash added.

The dry nitrate of silver is formed of

	Proust.	Berzelius.
Nitric acid . . . .	30.5	31.81
Oxide of silver . . . .	69.5	68.19
	<hr/> 100.	<hr/> 100.

Two parts of silver always produce, in practice, three parts of the *lapis infernalis*, or lunar caustic.

The nitrate of silver possesses, in common with the other nitrates, the property of being decomposed by a continued heat; but it is one of the small number of those, whose bases can be completely reduced, by reason of the little affinity it has for oxygen. And thus, by continuing to heat the nitrate of silver, we successively disengage the oxygen, the nitrous acid, and the azote, and there finally remains the metallic silver. We have often occasion to recur to this characteristic, to detect the presence of the nitrate of silver, it is sufficient to place a portion of it upon burning charcoal: the nitrate is decomposed, and there remains a pellicle of silver. One of the most striking pro-

perties of the nitrate of silver is, that it blackens the organic substances which it is brought into contact with; it at first produces a grayish tint, then a blue one, and finally a blackness, which resists all the re-agents; and thus we employ it to imprint upon cloth an indelible mark\*. We have also long used it to blacken the hair. The nitrate of silver forms the basis of various liquids, which are sold at very high prices by the hair-dressers and perfumers. They usually employ for this purpose the crystallized nitrate; but it is much better to use the fused nitrate, because it is certain to be perfectly neutralized, and may thus prevent the mischievous effects which are produced from the excess of acid, which is ordinarily contained in that which is only crystallized.

The nitrate of silver in solution, is one of the surest tests known to detect in any liquid whatever, the presence either of the hydrochloric or muriatic acid, or of any muriate; and this, by reason of the great insolubility of the chlorate or muriate of silver which is produced. Thus, when we find a white precipitate is caused by the addition of a few drops of the solution of nitrate of silver to any liquid, and that the precipitate thus produced is not dissolved by adding the nitric acid in excess, we may be certain that the hydrochloric acid exists in that liquid. As the proportions of the chlorate of silver are well known, it is easy, by collecting the chlorate, and weighing it after it has been well dried, to ascertain the proportion of the hydrochloric acid which was contained in the quantity of liquid submitted to examination.

Zinc, iron, and especially copper precipitate silver in the metallic state, from its nitric solution; and this property is employed to profit in the arts, in order to separate the silver from the other metals with which it may have been combined, as well also as to cover them with the precipitated silver, and thus to produce a true *silvering*.

\* The late Baron Edelfcrantz used a silver stamp for this purpose.—EDITOR.

We have above stated, that the surgeons employ the fused nitrate of silver as a most powerful caustic, in the form of small cylinders, which are capable of being held in a kind of silver *port-crayon*; they must not be touched with the fingers, as they would blacken the skin. We touch lightly, but repeatedly, with the moistened extremity of the stone, the affected part we would cauterize; and, finally, wipe the stone with a piece of fine linen cloth, before laying it aside. When we would apply the caustic to cavities, which are either too narrow or too deep for the cylinder to penetrate, we moisten the point of it, and rub it over with a long needle made of silver, like a knitting-needle, and then withdrawing it; it remains coated over with a slight layer of the caustic, and which can be thus introduced with facility into all cavities where it may be necessary to employ it.

We also employ the nitrate of silver in solution, but in a very great state of dilution, as a collyrium; and principally in the cases of those poor persons who are afflicted with ulcers, occasioned by inflammations of long continuance.

We also prescribe the nitrate of silver in solution, as a medicine in cases of epilepsy, and it is said, with remarkable success; but it so dangerous a remedy, that it ought to be administered by none but the most skilful practitioners. The skin of persons who have been thus treated, assumes a coppery hue, which is not soon removed.

We also employ the nitrate of silver as a powerful antiseptic; but unfortunately its poisonous qualities will not permit us to employ it in preserving our alimentary substances, although it can be used in the preservation of certain anatomical preparations; but for this use corrosive sublimate is without doubt preferable, as it is not liable to blacken, like the nitrate of silver, the organic tissue.

*Nitrate of barytes.*—This salt is obtained by either decomposing the native sub-carbonate by the nitric acid; or

by converting the sulphate of barytes, first into a sulphuret, and then into a nitrate. Each of these processes has its advantages and its inconveniences. The first is but rarely employed in France, because we are obliged to procure the sub-carbonate from foreign parts, and its price is too high to use it with economy in place of the sulphate. Nevertheless, there are some cases in which we are obliged to employ it in spite of its dearness; thus, for instance, when a laboratory is so constructed or situated, that we cannot disengage the sulphuretted hydrogen without danger.

The sub-carbonate of barytes, however finely powdered, is acted upon with difficulty by the nitric acid, and it appears that this is occasioned by its molecular aggregation: it is certain that the acid penetrates it much more readily after it has been submitted to a heat sufficient to make it red-hot. It is well to dilute the acid with a little water, because the nitrate of barytes not being very soluble, covers the carbonate, and becomes an obstacle to the progress of the operation; it is also equally advantageous to place the earthen vessel in which the decomposition is performed, in a water-bath, in order to facilitate it. When the liquid has obtained the neutral point, we filter it through paper, and evaporate the filtered liquid.

In order to prepare the nitrate of barytes from the sulphate, we first reduce it to a very fine powder, and mix it with a quarter of its weight of charcoal powder, also finely pulverized; we put this mixture into covered crucibles, well luted, and submit it to a strong calcination. We are obliged to employ a high temperature, in order that the charcoal may act upon the acid in the sulphate in such a manner as to seize its oxygen, and to form with it, and the carbonic acid, the gaseous oxide of carbon; and the sulphur remains fixed in the primitive base, in union with the sulphuric acid.

When the calcination has been sufficiently prolonged, the powder, which was black at first, will have become of

a grayish ash colour; and instead of being loose, it will agglomerate: it forms a spongy mass of easy solution in the saliva, to which it gives a decided taste of sulphur.

Some manufacturers advise us to grind this mass in water, and immediately pour the nitric acid upon it; but as the sulphate always contains a certain quantity of iron or manganese, and it is found inconvenient to dissolve at the same time these metallic oxides; and as there is always found a portion of sulphate which is not changed, and which forms a considerable residuum, which it is difficult to separate from the last portions of the nitrate, and as the value of this is so great, so others advise us to commence by boiling the ley of sulphur in water, and finally to decompose the solution by the nitric acid.

This ley of sulphur presents a phenomenon, which is sufficiently remarkable to deserve notice; this is, that when sufficiently concentrated, it affords, on cooling, white hexahedral crystals, which are a hydrate of barytes; these are probably formed by the attraction of cohesion, which, at the moment of crystallization, causes the less soluble bodies to be precipitated; whilst, on the other hand, it facilitates the formation and combination of the more soluble ones which remain in the liquid, and form what is often called the *hydrosulphate of sulphur*. When we filter this ley, and decompose it by the nitric acid, the sulphuretted hydrogen produces a brisk effervescence, and an abundance of sulphur precipitates at the same time, which renders the liquid milky. It is well to burn off this hydrosulphuric acid as fast as it is produced, in order to hinder it from incommoding us; and it is an essential precaution, either to perform the operation in the open air, or at least where there is a free circulation; and to carefully avoid operating in a place where there is no chimney. Many accidents have happened from neglecting to guard against the effects of this dangerous gas; and we cannot, therefore, too much recommend caution to practitioners.

When the effervescence ceases, which shows that the liquid contains a slight excess of acid, we cease to add any more, and then heat the liquid, in order to drive off any portion of sulphuretted hydrogen which may remain in solution; we then let it cool, filter it, and finally evaporate it, in order to obtain the crystallized nitrate of barytes. The first crop of crystals are fine; but at each succeeding evaporation of the nitrate, they become more and more coloured by the oxides of iron and manganese which they combine with, in spite of all the precautions we may take to prevent it.

As the principal employment of this salt is to serve for the preparation of caustic barytes, and as the presence of these oxides lessen its purity, so we are obliged, in order to free it from them, to grind the nitrate to powder, and submit it to a slight torrefaction, which, by superoxidizing the iron and manganese, destroys their combination with the nitrate of barytes, and permits us to separate them, by again dissolving the nitrate, and filtering the solution.

The nitrate of barytes crystallizes in octahedrons and tetrahedrons, which are transparent at their edges, but nearly opaque every where else; these are soluble in twelve times their weight of water, at the temperature of  $16^{\circ}$ , but only require three or four of boiling water. As this salt contains but little water of crystallization, so it decrepitates like common salt, when submitted to the action of heat; it also undergoes the same changes from this element as the other nitrates, and it is the only salt from which we can prepare the caustic and anhydrous barytes.

The nitrate of barytes is employed in our laboratories to detect the presence of the sulphuric acid, or of sulphates, in any liquid whatever. It has been long employed by the makers of artificial fire-works to modify the colours of certain flames, to which it communicates a yellowish hue.

The nitrate of barytes is composed of

	Kirwan.	Vauquelin.	Richter.	Berzelius.
Acid . . .	32 . .	38 . .	39 . .	41.44
Base . . .	57 . .	50 . .	61 . .	58.56
Water . .	11 . .	12 . .		
	<hr/> 100	<hr/> 100	<hr/> 100	<hr/> 100

*Nitrate of bismuth.*—The preparation of this salt presents no difficulty; but as the bismuth of commerce generally contains a considerable quantity of arsenic, so it is well, in order to purify it, to keep it a considerable time in fusion: the arsenic is partly dissipated by this means, but not entirely. If, however, we grossly pulverize the purified bismuth, and throw it by portions into the ordinary nitric acid, a little diluted with water, it produces a brisk effervescence of nitrous gas. Part of the metal is dissolved, and the remainder lies at the bottom of the vessel, in the form of a white powder, which is generally considered as a sub-nitrate, but which we think is composed of the arseniate of bismuth, which is formed by the re-action of the nitric acid upon the two metals. A part of this arseniate is retained in solution, favoured by the excess of acid, and precipitates when we evaporate the liquid, in order to obtain the crystallized nitrate of bismuth.

This salt crystallizes in large flat prisms, terminated by pyramids; it is not transparent, but of a grayish appearance, the crystals being of a blueish white colour; water decomposes them, by seizing the acid, and precipitating the insoluble sub-nitrate; this, when well washed and dried, is a powder of a very white colour, exceedingly soft to the touch; but it possesses the unfortunate property of becoming black, by the slightest emanations of sulphurous vapours. But the clearness of its white colour, and its readiness to mix with other bodies, causes it to be employed under the term *blanc de fard*, a name by which it has long been distinguished; as well also as to dilute other colours, without altering the purity of their tints, such as rouge and

carmines, both equally used by the ladies. It is also used in many other arts, and particularly in the manufacture of coloured sealing-wax; and it is likewise employed to lighten the tints of other colouring materials. It is also used, with other substances, in the making of false pearls; from which it has acquired the name of pearl-white.

The makers of enamel add the white of bismuth to one of their compositions, in order to increase its fusibility.

When we merely prepare the nitrate of bismuth in order to obtain the sub-nitrate, as is generally the case, we do not crystallize it, but content ourselves with throwing the solution into a quantity of water; we then agitate it strongly, and leave it to settle; we afterwards wash it, and decant the water off, and form it into masses, after leaving it for a sufficient time to drain upon a cloth filtre. It may not be useless to repeat, after what we have above stated, that in order to give this process all the desirable success, we must take care to perform it at a distance from all sulphureous exhalations.

The sub-nitrate of bismuth may be obtained under the form of brilliant pearly scales, if we cause their precipitation to be slowly effected, by employing acidulated water, instead of pure water.

The crystallized nitrate of bismuth is composed, according to the analyses of Lagerhielm and Berzelius, of

Acid . . . . .	33.84	. . . . .	40.70
Base . . . . .	49.31	. . . . .	59.30
Water . . . . .	16.85		
	100.		100.

And the sub-nitrate, according to M. Grouvelle, of

Acid . . . . .	13.97
Base . . . . .	81.37
Water . . . . .	4.66
	100.

## XLV.—MISCELLANEOUS.

*Specification of a patent, obtained in the United States, for an improved mode of fixing the mariner's compass, by Mr. LEMUEL LANGLEY, dated May, 1828.*—"Lemuel Langley, of the town of Norfolk, in the state of Virginia, has invented an improvement in the mode of fixing the Mariner's Compass, which is described in the words following:—

"The object of my improvement is to dispense altogether with the binnacle, in which the Compass is ordinarily fixed, to cause it to answer all the purposes of a tell-tale, and to secure it against accidents from cannon-shot, the shipping of heavy seas, or any other cause of injury. The mode in which these ends are attained, is by cutting a hole through the deck of the vessel, at or near the place where the binnacle is usually situated; this hole is cut through into the cabin, and within it is placed the Compass with its box, suspended in the usual way; and when so situated, it is completely out of the reach of cannon or other shot. In order to cause it to act as a *tell-tale*, the compass-box is made with a glass bottom, so that the card can be seen as perfectly in the cabin as upon deck. I also make the compass-card translucent, or semi-transparent, in consequence of which it may always be lighted from below, and will be much more plainly seen at night than when lighted in the ordinary way. The compass is defended at top by a very thick piece of glass; such as I have used has been three-fourths of an inch in thickness, and this is also defended by a rim, or band, projecting above the deck; the lower side of the box is also glazed; and I contemplate sometimes making the sides of the box of glass, should it be desirable to admit light in that way.

"What I claim as new in the above described invention, is the fixing of the compass entirely within the planking of the deck of a vessel; and the mode of rendering it equally visible, both upon deck and in the cabin.

LEMUEL LANGLEY."

*Remarks, by Dr. THOMAS P. JONES, Editor of the  
Franklin Journal.*

We have seen but few things better calculated to answer the intended purpose than the foregoing invention. Whilst the deck of the vessel remains, the mariner's only guide, the compass, is perfectly secure. The small projection, which it has been thought best to give to the glazed rim, may be completely protected from cannon shot, by a wide plate of iron fixed around it, so as to rise a little higher than the rim, whilst its edges are level with the deck.

A British vessel was in the port of Norfolk, when Mr. Langley was fixing one of his compasses on board a United States vessel, the captain of which preferred it very much to the costly binacle and tell-tale with which his own ship was furnished; there is but little doubt, therefore, that we shall see the invention patented in England, as it is not there required that the patentee should be the inventor. Mr. Langley, we believe, has not taken any measures to secure it to himself in that country. We frequently recognise the improvements made by our countrymen in the accounts of English patents; of this we have no right or inclination to complain; but we cannot help feeling, that justice requires that the credit of having made useful inventions or discoveries, ought to be given to the country to which they belong; the situation of the Editor will enable him hereafter, to attain this end in almost every instance; and his inclinations will lead him to give it the required attention.

*An Improvement in water-wheels, patented by ABEL GREENLEAF, of Mexico, Oswego Country. New York, June 5, 1825.*—The plan proposed is, to employ two or more water-wheels; where wheels of the undershot kind are used; the second wheel to be acted upon by the water after it has left the first; the two wheels to be geared together by an intermediate cog-wheel, or to be connected by

a band, passing over drums upon the wheel shafts, so that in either case, the motion of the second wheel shall be about one-third less rapid than that of the first; it being estimated that the water will strike it with a power diminished in that proportion. The fall may be divided into two parts; giving such a descent to each, as shall cause the action to be nearly in this proportion.

*On the progress of inventions connected with navigable canals\*.* (From the Boston Journal of Science.)—

The triumphant progress of the Great Western Canal, begun a few years since, by the state of New York, has fixed the attention of the public to works of this kind, in a degree perhaps unprecedented in any other country. In every district in the United States canals are projected; and such are the supplies of water, and so favourable are other circumstances, that very few of the projects appear either chimerical, or at least so far as the public are concerned, useless.

This advantageous mode of intercourse of traffic is, in some of its most important parts, of modern invention; although some of the canals of the ancients were designed for commercial intercourse, and on all it might be practised in a degree; yet, irrigating and draining the land were the ends proposed by most of the canals known in the early ages. The limit which the state of knowledge fixed to all works of this kind, will be fully perceived, when it is recollected that locks, and consequently different levels, were unknown until within a few centuries. The ancient canals, therefore, were no more than artificial rivers, which could be made only through countries nearly level; and which, in cases of deviation from that direction, not only presented the obstacle of rapids to the passage of boats, but required constant attention and labour, to preserve the embankments from destruction; and perhaps the neighbouring country from inundation. Such were the

\* From the Franklin Journal.

canals of India, Egypt, and ancient Italy; and such at this day are the canals of China. Notwithstanding, however, the imperfection of these works, from the want of knowledge, some of them were formed on that scale of grandeur, which so strongly characterises the productions of ancient art. There seems to be good authority for believing that the Red Sea was once united to the Nile by a canal. One entrance of this canal is said to be yet remaining. The canal of Alexandria, which united that city with the Nile, still exists, although in a ruinous state. Formerly the great productions of Egypt were carried through this channel to Alexandria, thus avoiding the dangerous navigation of the mouth of the Nile, from whence they were shipped to Europe. The whole number of canals in Egypt is said to have amounted to eighty, some of which were forty leagues in length, and in some places nearly three hundred yards in width. The Greeks have left no great works of this kind; at least none for the purposes of navigation. A cut through the isthmus of Corinth, which would make a navigable passage from the Ionian Sea to the Archipelago, though often proposed, was never effected. The canals of ancient Italy were neither numerous nor extensive. They were designed for the double purpose of drains and navigation. Such were the canals of the Pontine marshes, and those in the neighbourhood of the Po. In England, however, a Roman work, now called the Caerdike, formerly united the Nyne, near Peterborough, to the Witham, below Lincoln. It was nearly forty miles in length; and from the ruins which still remain, must have been very broad and deep. Another canal, supposed to have been a Roman work, is still navigable, and connects Lincoln with the Trent, above Gainsborough, by one level of eleven miles. These canals are both situated in the English fens, and are of course natural levels.

It has been believed that locks were unknown to the ancients; they are still unknown to the Chinese. Some

of the canals of China, however, are constructed on different levels; and their method of passing boats from one level to another is worthy of attention. The levels are connected by inclined planes constructed of hewn stone. These inclined planes, in some instances, connect levels differing fifteen feet in elevation. In passing from the upper to the lower canal, the boat is raised out of the water, and launched over the inclined plane, the last part of the operation, of course, requiring no great labour, as the friction over the plane retards the descent of the boat. But in passing from the inferior to the superior canal powerful engines are required. These consist of capstans, from which ropes are passed round the stern of the boat. The efforts of a hundred men are sometimes required to effect the elevation of a loaded boat. The objection to this mode, taken in this simple and rude form, lies not only in the great labour required by it, but in the injury which must necessarily be done to boats. The practice could never be adopted with the slightly timbered barges used in our canals, which are calculated to be supported by the fluid in which they move, and which presses with a force perfectly equal on every part with which it is in contact. There are some situations, however, where from the scarcity of water, the inclined plane is necessarily substituted for the lock. Some works of this kind are used on the continent of Europe; and in England, in some cases, where the weight of the descending greatly exceeds that of the ascending commodities; as in the traffic between mines and furnaces, inclined planes are used with advantage. In these situations the descending and loaded boat is made to drag up an ascending one which is empty, or but lightly loaded; thus exhausting in a useful purpose, a force, which not being expended in friction, as rollers or wheels are used between the boat and the plane, could not be otherwise controlled without some labour and cost.

(To be continued.)

## LIST OF PATENTS FOR NEW INVENTIONS,

*Which have passed the Great Seal since March 2, 1829.*

To George Haden, Ironbridge, in the county of Wilts, engineer; for certain improvements in machinery for dressing cloths. Dated March 2, 1829.—To be specified in six months.

To William Storey, of Morley, in the parish of Batley, in the county of York, plumber and glazier; and Samuel Hirst, of the same place, clothier; for certain materials, which when combined, are suited to be employed in scouring, milling or fulling, cleansing, and washing of cloths and other fabrics; and by the employment of which materials, considerable improvements in those processes are effected. Dated March 10, 1829.—In six months.

To Richard Hall, of Plymouth, in the county of Devon, tailor and woollen draper; for a composition, applicable to certain fabrics or substances, from which may be manufactured boots, shoes, and various other articles. Dated March 10, 1829.—In six months.

To James Willis Wayte, of Drury Lane, in the county of Middlesex, printer; for certain improvements in printing machinery. Dated March 19, 1829.—In six months.

GILL'S  
TECHNOLOGICAL & MICROSCOPIC  
REPOSITORY.

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XLVI.—*On the Microscope.* By the EDITOR.

(Continued from page 199.)

WITH FIGURES.

*On the singular structure of the pith of the rush.*—The general structure of this beautiful microscopic object is exhibited in fig. 1, of plate V.; it being composed of a series of tubes, arranged in triangles, and forming hexagons, grouping into each other with much regularity; and each tube being divided in its middle by a valve.

Sometimes, however, the structure differs in the manner shown in fig. 2, where several oval forms are shown intermingled with the former arrangement; and other tubes also branch off, which connect with the layers underneath and above them; and towards the bark of the rush the tubes are crowded much closer together, and lose much of their regular arrangement.

The pith of the rush may be freed entire from the bark, by sticking two pins through the upper or smaller end of the rush, at right-angles to each other, and as shown in fig. 3; and then taking that end of the rush between the teeth, and carrying the pins along towards the end of it, the bark will thus be divided into four stripes, which separate themselves from the pith, which is driven along before the crossed pins out at the root end of the rush, in a greatly compressed and contracted form indeed, but it quickly extends itself again by its elasticity, and regains nearly its original length.

VOL. IV.

The Editor was instructed in this curious method of freeing the pith of the rush from the bark, several years since, by a lamp manufacturer from Amsterdam; where, and also in other parts of the Netherlands, it is commonly used for the wicks of lamps; the pieces of pith being stuck upright into holes, formed in the thickness of the shallow and broad earthenware vessels constituting the lamps; but of course the holes do not pass through their bottoms. The wicks stand at first somewhat above the surface of the oil, and upon being lighted, instantly shorten to a proper burning height, and then gradually burn away as the oil consumes, and without needing to be snuffed or continually trimmed, as the cotton wicks of our lamps require to be.

If a piece of the pith of the rush be set fire to, but without inflaming it, it will continue to moulder away nearly to ashes, the red-hot part following a winding course as it burns; and the remainder, after the burning, will assume a helical or screw-like form, similar to that shown in fig. 4. This affords another example of the very singular conformation of this curious substance, and indeed was an accidental discovery of the Editor's making some years since.

*On the seed-vessel of the anagalla, pimpernel, or scarlet chickweed.*—In our third volume, page 143, we gave an account of the beautiful structure of the flowers of this delicate plant, together with several figures of parts thereof; to this we have now to add the microscopic appearance of the outward coat of the spherical seed-vessel of it, under highly magnifying powers, and as shown in fig. 5.

It would seem that Nature here has determined to show how widely she could depart from the geometrical exactness and symmetry displayed in the structure of the pith of the rush, in the elegantly sinuous or winding forms of the frame-work of this vessel; and which indeed is no bad representation of the carvings given by the stone-mason to his rustic basements.

*On the singular structure of the leaves of the sphagnum*

*palustre, or white bog moss.*—In plate V., fig. 6 represents a small portion of one of these leaves, viewed under the power of a single lens, the twentieth of an inch focus; here again we have a curious instance of the vagaries of Nature in the structure of this leaf: it resembles a sort of irregularly shaped frame-work, laced together across.

*On the larva, pupa, and exuvia of a straw-coloured plumed culex or gnat.*—Having lately been favoured by Mr. C. Gould, with several of these curious larvæ, and which form one of the principal subjects figured in Pritchard and Goring's new work, "*On Living Objects for the Microscope*;" and which Mr. Gould had procured from a pond in the vicinity of Epping Forest; and having since kept them in a phial, with frequent renewals of the water from time to time, we found several of them change from the larva into the pupa state, and one of these latter again into the perfect culex, or gnat; leaving, of course, its exuvia floating upon the surface of the water. This exuvia we secured, and placed between glass slips, and were glad to find that it retained several of the most interesting features of the pupa; and in particular the two curious reticulated cases, which enclosed the antennæ of the gnat, are perfectly preserved; so likewise are the two delicately thin webs at the hinder extremity of the body of the pupa. These webs are employed by the pupa in swimming, and supporting itself in a *vertical* position in the water, the larva always preserving a *horizontal* posture: and before the change of the pupa into the gnat, its upper part became of a very dark colour, which may be noticed as an indication of its approaching metamorphosis.

This pupa presents a curious appearance in the water, its antennæ, in their oval cases, seeming like two horns standing upright above its head; and its two black eyes in the front, together with the markings of its abdomen, gives it altogether the resemblance of a skull affixed upon a skeleton, and which latter name it has acquired in consequence.

The larva is admirably fitted with the means of swimming, in the beautiful radiated and feathered appendages to its tail; but which are entirely changed in its pupa state, into the two webbed appendages above-mentioned. It is likewise furnished with a most singular apparatus for seizing and devouring its prey, and which consists of two powerful branches, articulated in the front and upper part of its head, each having four stiff hairs descending from it, and with these it can bring the minute animalculæ within reach of its jaws, which are armed with teeth, well fitted to perform their office of destruction; besides these instruments, it is likewise furnished with a tongue, having tufts of hairs upon each side of it; other tufts of hairs are likewise affixed to the jaws upon each side; and thus, between its seizing, sweeping, and devouring instruments, there is hardly a chance left for its prey escaping. Its eyes are also very curiously formed, they being compound ones, but not having reticulated corneas; on the contrary, they consist of a considerable number of pear-shaped bodies united together; as appeared, on the Editor endeavouring to preserve one of the larva as a transparent object for his microscope, between two slips of glass, when its eyes separated into these pear-shaped bodies, in consequence of the pressure made upon them; and indeed the larva itself loses its shape when placed between glass slips, in consequence of the great quantity of glutinous matter which escapes from it; and which shrinks up consequently, and changes its figure in drying.

It does not appear that this insect feeds in its pupa state, it not being furnished with the needful apparatus for this purpose. It is not left, however, without the means of annoyance or defence, it having two curved and serrated appendages at its abdomen, which seem admirably fitted for these purposes.

*On the animalcula termed the urslet.*—Our first stock of these urslets, mentioned in our last number, page 193, perished in a few days' time, owing to the leaves of the *lemna*,

or duckweed, which they frequent, becoming decomposed, and giving out hydrogen gas; and which not only proved fatal to the urslets, but also to the flesh-coloured polypes, and other animalculæ contained in the same vessel with them. In consequence of this accident, we have been obliged to procure a fresh supply of the urslets from the pond, the situation of which we pointed out in our former notice of them; and these, notwithstanding our care in distributing the lemna into various vessels, leaving only a little in each, and often changing the water for fresh, we have only been able to keep alive about three weeks, they being most of them dead, or in a dying state; so that we must again have recourse to the pond for a third fresh supply.

There can be no doubt of the urslet being a perfect animalcula, and not the larva of an insect, as has been supposed; as several of those we had, contained dark coloured globular eggs within them; and they are of different sizes, some not being a quarter the size of those with eggs within their bodies.

Figures of the urslet will be found in Dr. Brewster's Edinburgh Encyclopedia, to which we must refer our readers.

*On singular cells, and circular plates, attached to a red North American marine conferva.*—Since our last number, we have been gratified by Mr. R. Brown, of the British Museum, with a sight, under his microscope, of a species of red marine conferva, with serrated leaves, and having attached to them beautiful cylindrical cells, with hemispherical ends, and which are perforated all over in a very regular manner with holes. There are also affixed upon other parts of the leaves, flat and circular bodies, which are also perforated all over with holes and radiating lines, and may possibly be the foundation for other cells. We trust that Mr. Brown will, at some future period, favour the scientific world with accurate figures and descriptions of this confervæ, as well as of that beautiful one from Van Dieman's

Land, which we mentioned in page 136 of our present volume.

*On La Torre's Work on the Microscope.*—In our article in the present volume, "On Glass-working in Miniature," by the celebrated Abbé Nollett, he mentions this work with considerable commendations; and states, that La Torre's fine microscopic observations upon various subjects of Natural History, were made with the assistance of *globules* of glass, of his own manufacture! We have lately been favoured with a sight of this very scarce work, in the library of the British Museum, by Mr. R. Brown; and fully agree in the favourable opinion expressed by the Abbé Nollet, of the great excellence of the delineations contained in the work; and indeed, without seeing them, we could never have believed that glass spherules or globules were capable of affording such accurate views of the objects, as must have been the case, to enable him to delineate and to furnish such excellent engravings of them.

*On Mr. Bancks, jun.'s single microscopes.*—We are glad to find that the present increasing desire for studying microscopic objects, has encouraged our opticians to exert their talents in the improvements of microscopes; both by rendering them more convenient and manageable, and by grinding single lenses of highly magnifying powers.

We were lately gratified with the sight of a microscope, constructed by Mr. Bancks, jun. of the Strand, and with lenses of his own grinding, of the sixtieth, and we believe even of the eightieth of an inch focus; and the performance of which was highly satisfactory, when employed in viewing several of the most difficult test objects.

Mr. Bancks had likewise availed himself of a *bronzing process*, in giving a dark hue to the brass-work of his magnifiers, instead of blackening them as usual with varnish; and with an improved effect in point of neatness, which is deserving of imitation.

*On the exuvia of the pupa of the above-mentioned plumed gnat.*—Several of these pupa having changed into gnats,

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we have placed one of their exuviae between glass slips, as a beautiful transparent object for the microscope; the curious reticulated cases which contained the jointed and plumed antennae being perfectly preserved in it; as are also the delicate webs affixed to its tail.

(To be continued.)

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**XLVII.**—*On the Scales of the Papilio Cethosia Julia; and on various Dermestes, Fleas, Ticks, &c.*

DEAR SIR,

London, April 10, 1829.

I SEND you a variety of objects selected from my collection, which you will be pleased to examine at your leisure under your microscope, and favour myself and others of your microscopic readers with your remarks on the characters you may discover in them.

I begin with a few scales taken from the wings of a foreign butterfly, the *Cethosia Julia*. Some of these scales you will find to be of a most singular shape, and differing very much from all I have hitherto taken from the wings of lepidopterous insects; there are two sorts, both of which are very fine test objects, the lines in them being very difficult to make out with the most powerful lens. The shorter ones I found on the pale yellow band, which crosses the upper surface of the under wing; the longer sort are to be met with on the ribs of the wings. In the glass slider which contains these scales is also a small portion of one of the wings, on which a double layer of scales lie, and cross each other in a very curious manner.

In my letter, published by you in the third volume of your work, page 281, I had occasion to mention the injuries we sustain from various species of dermestes; and also the fine hairs with which the exuviae or cast skins of their larvae are covered. I now send you some of those cast skins, together with an account of the method I took in order to procure them, and by following which, you may readily

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furnish yourself with a series of these interesting microscopic objects.

Having met with a small larva in a box of insects, I put it into a pill-box, with a dead fly for its sustenance, which it fed upon, until the period arrived of its casting the first skin. The insect having accomplished this, soon after appeared in full vigour, had increased in size, and continued to feed on the fly as before. During the time I kept it in the box it threw off five skins, each succeeding skin becoming larger; these five skins I enclosed between slips of glass; by this time the insect had nearly eaten up the fly; and when it threw off the next skin, scarce any of the fly was left; which it, however, soon devoured, and then began to eat its own cast-off skin. I had some thoughts of seeing how many skins it would have cast off before it changed into the perfect insect, but being apprehensive it might escape from the pill-box, and get to my cabinet, I killed it by putting it into boiling water. This insect, together with the skins, I send for your inspection. You will find them covered with numerous curious hairs, many of them terminating in points resembling the heads of spears.

I also send you a few cast skins, taken out of a box of Brazilian insects, which have been much damaged by the larva of a dermestes. There are some curious characters in some of these skins, and particularly in those placed between a glass slider.

The mischief which the various species of these insects do in their larva state is almost incredible; some of them had got into the cushions of a set of chairs, and which they so completely spoiled, as to render them unfit for use. I send you the larva and perfect insect of this species.

Some time back I met with the crysalis case of a fly, which I put into a pill-box, and expected, in due time, to have had a species of musca come forth; instead of which, however, the larva of a dermestes presented itself, after having devoured the fly while in its pupa state; and for

want of other food, it had actually eaten part of the crysalis case which had enclosed the pupa of the fly. This larva had also cast one skin, which I send with the larva, and the remains of the crysalis case of the fly.

With these you will likewise receive the larva of a different species to the last. This I found doing much mischief to a piece of woollen cloth. On examining it, I found it was not only covered with hairs, but also with multitudes of scales, and many of them differing from each other; some few I scraped off the insect, and placed them between slips of glass, which now accompany the insect.

In removing a diamond beetle, which had been in the cabinet of the late celebrated Dr. Letsom, it fell to pieces; and on my examining the beetle to ascertain the cause, I found the interior of the body had been the habitation of a dermestes, and within which it had undergone all its changes, and had arrived at its perfect state. While in the larva state, however, it had eaten up every part, except the shelly covering of the beetle, casting its skins in succession. The diamond beetle appeared to the eye to be in a sound state, but on removing it from its situation, it literally fell to pieces.

With these I also send you the larva of another species, and which are so destructive to stuffed birds, and make such devastations in the cabinets of the ornothologist; and also another larva, found under the bark of the willow, with numerous tufts of hair round its head and body of very beautiful characters.

A friend sent me a box of insects from New South Wales, in which box were also a few seeds, covered over with their fibrous skins; in the same box I observed several larvæ of the dermestes, of two different species, and varying in shape and size; the larger kind I observed were preying on the insects, and the smaller ones on the seeds; some of the skins which enclosed the seeds they had so dissected, that nothing remained but the fibres; a portion of the skin I enclosed between talc-sliders, and which con-

tain also the cast skins of the smaller larvæ, together with the dissected compound eyes of a foreign moth, the head of which I found in the box ; and between another glass slider are the cast skins of the larger larvæ ; and on pieces of card are the large and small larvæ, from which the skins were cast off. These cast skins you will find on examination highly interesting microscopic objects, some of them being covered with hairs of various characters ; others with a profusion of curious scales, a quill at one end of the scale, and a point at the other ; which scales have also broad striæ, and are likewise dotted all over ; but you must examine them yourself under the microscope, in order to discover the exquisite workmanship displayed throughout the cast skins of these destructive little insects, as it is impossible to do justice to them by description.

~~Between~~ another glass slider now sent you, you will find the dissected proboscis of a flea, taken from the hair of a cat. The sheath is divided into two parts, and it contained within it three instruments, which I have taken out and separated. There are also the two feelers, and the two fore legs, together with some of the muscles attached to them, and in which you will perceive their curious structure.

I also send you several fleas which I found on moles during the last year, and some of which are of an extraordinary size and figure ; these are covered over with very curious reticulated scales, and strong spines to them ; their eyes are very [small, and like those of the mole on which they prey, are scarcely visible. There are likewise some other fleas, which I found in a swallow's nest ; these, as well as those from the mole, have antennæ, lying within a groove or cavity at the side of each eye, and which antennæ the insects can elevate or raise at pleasure : this circumstance I pointed out to my friend, Mr. John Curtis ; at the same time also presenting him with one I had taken from a mole, with its antennæ elevated like the ears of a rabbit.

I also found upon a bat, which was nearly dead, several fleas and their eggs; some of these eggs I placed between talcs in a slider, and in the course of a few days a caterpillar was excluded from one of the eggs, the shell of which it devoured, having nothing else at hand on which it could feed. The other eggs still contain the caterpillars within them, which you will perceive, as I have sent the slider containing them; as also one of the fleas themselves, together with a small portion of hair taken from off the same bat.

With these you will likewise receive some minute ticks, which I also found on the mole above-mentioned. It appears that every animal, both on land and in the water, is infested either with a tick, or some other parasite, which derives nourishment from the animal it attaches itself to, from the great Leviathan, down to the minute *monoculus*; and which last, small as it is, I have yet seen in the spring of the year, covered over with multitudes of minute polypes, of a bell shape; even the fine branches of its horns have been hid, from the vast numbers which covered them. This circumstance you may now witness yourself, by examining the monocoli now exhibiting by our friend, Mr. Philip Carpenter, at his Microcosm, in Regent Street.

I send you also a few small ticks from the whale. These insects are found in great abundance under the fins of the whale, they are furnished with ten very strong legs, with sharp claws to them, which enable them to stick close to the fish. Some of these insects are found of a large size, they are then very opaque; but these I send you are transparent, and would make fine objects for an exhibition under the solar microscope, as their figure differs very much indeed from every other species of tick. Those found on the peacock are of a very singular shape. I was once spending a few days with a friend in the country, who kept one of these birds, and which I observed was in a very drooping state, and was continually scratching its head in a violent manner. I took an opportunity of catch-

ing the bird, in order to examine it, and was really astonished at the sight that presented itself. The poor bird was literally covered with multitudes of these troublesome parasites, from its beak down to the bottom of its neck ; every feather was off, and one of its eyes was out, occasioned, no doubt, by its continual and violent scratching, to relieve itself from the vermin ! With the assistance of my friend's gardener, I relieved the poor bird from many of these annoyers ; and having rubbed the parts with a slight mercurial ointment, I had the pleasure of observing a few months afterwards, the bird in a healthy state, and with all its fine plumage restored ; but the eye was completely gone. Some of these insects I send for your inspection.

My friend, Mr. George Samouelle, of the [British Museum, when on an entomological excursion in the New Forest, observed several horses covered with ticks, the *hippobosca equina* ; they were so very numerous, that he obtained from the flanks of one horse only, six handfulls ! They attach themselves to the horse by means of their sharp claws, each foot being furnished with four. This insect is very difficult to kill, as it may even be very strongly pressed between the fingers without being apparently injured ; the female carries its egg within the abdomen, which is so large as to fill up the whole interior. But in fact this apparent egg may be considered as the pupa ; for when discharged from the insect, it undergoes no other change, than the perfect insect coming forth in due time from within it. One of these insects had also got under the flank of my horse while in the stable, and annoyed it so much, that the animal became quite infuriated, plunging and kicking about in all directions, so that it was with the greatest difficulty that I could approach to take the insect off ; when I had succeeded, I endeavoured to kill it, by rubbing it between my thumb and finger, but its tough skin resisted all my efforts. I therefore put it into a pill-box, and on opening the box sometime afterwards, I found it had deposited its egg or pupa, which I now send you,

together with the identical insect, as also another specimen, with the egg or pupa within its abdomen, showing the great size to which the abdomen is distended.

In the summer of 1817, I was standing near the market-place at Horsham, in Sussex, when a swallow fell from its nest to the ground, near to where I stood. I picked up the bird, and found it overrun with a vast number of ticks, the *Hippobosca hirundinis*. These insects, I imagine, had so annoyed the bird as to cause it to fall from its nest! Some of the ticks I secured, but with great difficulty, as they ran exceedingly fast; the others I brushed off the bird, when, being relieved from its tormentors, it flew away with perfect ease and freedom. These insects are furnished with six claws to each foot, and they carry their eggs or pupa within them in a way similar to that of the horse. Some eggs having been discharged by them while in my possession, I herewith send you one, together with a perfect insect.

Although the difference in size between the horse and the swallow is very great, yet the parasites on each are nearly of the same size. Those from the swallow are not only found upon the birds, but if one of their nests is examined, they will also be found swarming within it. I recollect once sleeping in a room in a cottage, and just above the window were several of these nests; the window being open during the day, many of these insects were found upon a table which stood near it, probably occasioned by their falling from the swallows, as they went into and came out of their nests. I have even heard of persons suffering from their attacks, but did not experience any thing of the kind myself.

Mr. Kirby relates, that although its natural food is the bird after which it is named, yet it has also been known to make its repast on the human species. One, for instance, found its way into a bed belonging to the Rev. R. Sheppard, and where, for several nights, it sorely annoyed a friend of his, and afterwards himself, without their sus-

pecting the culprit. After a close search, however, it was discovered in the form of this flea or tick ; and which, forsaking the nest of the swallow, had, by some chance, taken its station between the sheets, and thus glutted itself with the blood of man.

I likewise enclose for your inspection a couple of ticks, of a different species from those before named ; these are, I believe, the *Hippobosca avicularia*. One of them was taken from the feathers of a crow, and the other from the body of a rook. These birds had several others of the same species on them, but they flew away before my friend could secure them. These, with the foregoing, you will observe have compound eyes, consisting of many thousands. I also send you another species of tick, which is frequently found on the sheep, and very often also attaches itself to man. By inserting a powerful instrument, which it has enclosed within its proboscis, into the skin, it sucks the blood ; and so firmly does it fix itself, that it is very difficult to dislodge it. This insect has strong double claws, and powerful muscular legs ; it is very nimble in running over the skins and among the fleeces of the sheep ; it is also very tenacious of life : according to Ray, it will exist in the wool of a fleece twelve months after it is shorn. The eyes of this insect are also compound ones ; but are neither so prominent nor so numerous as those already mentioned. There are likewise several curious markings down the sides of the abdomen, which very much resemble the eyes of spiders ; and, indeed, they have so much the appearance of the eyes found in some insects, that the late Sir Joseph Banks, who examined them with me, was so struck with their singular appearance, that he requested me to procure some living specimens, in order to have those characters more minutely examined ; and for which purpose I applied to an old shepherd at Tottenham, and whom I frequently had occasion afterwards to employ as my collector of these insects for several of my entomological friends, whose cabi-

nets were destitute of them. Some of these insects I procured for Mr. John Curtis, and who has given a very correct and excellent magnified figure of one in the cxlii. plate of his work on British Entomology.

I furnished Sir Joseph Banks with some of these sheep-ticks, and he sent them to Dr. Leach for his minute investigation of the parts before mentioned. The result was, that instead of being eyes, they were found to be the spiraculæ, or the organs of respiration. These insects, like the foregoing, also carry their eggs or pupa within their abdomen. Two of them, with their discharged pupa, I send for your inspection; the insects having discharged their pupa whilst in my possession. You will find these apparent eggs covered over with curious granulations; and, in the perfect insect, you will observe those organs which I mentioned resembled the eyes of spiders; and, on a card, I have placed some of their heads in such positions as that you may examine their eyes, the proboscis, and the piercing instruments contained within it. These instruments, on dissection, I find to be three in number, and when in a state of rest are enclosed within a sheath which divides into two parts; one of these instruments you will find separated from the others, which are between slips of glass, as also a portion of the skin from the abdomen, which is exceedingly tough, granulated, and covered with bristles, and in which you will observe those spiraculæ just mentioned; and between another slip of glass you will find several legs from these insects, with some muscles attached of curious structure; the claws appear to be serrated, and instead of having a spongy sole, like the feet of flies, they have strong fibres attached to each foot.

I also send you two different species of ticks taken from a goose. These differ much in shape from each other. They frequently quit their situation upon that bird, and then become torments to the poulterers, and other persons employed in picking the feathers from the geese.

With these you will also find various other ticks, taken

from the horse, the ass, and the zebra. In those from the horse, you will observe some curious markings in the skin, and also two globular eyes. The horse and the ass from which these ticks were taken, were most terribly annoyed by them, in consequence of their owners neglecting to clean and feed them properly.

I likewise send you some ticks from the pig. These two insects, together with some eggs which I found attached to the hair of the pig, you will find very curious objects when you examine them; the eggs have very singular granulations over their whole surfaces.

The dogs, our faithful guardians, likewise suffer much from a tick, which, when once it has fixed itself in their flesh, will, in a short time, from being only the size of a pin's head, so swell itself out by gorging their blood, that it will equal in its dimensions what is called the tick-bean! In the West Indies these ticks, or very similar ones, get into the ears and heads of the dogs, and so annoy and exhaust them that they either die or are obliged to be killed! One of the English ticks which I took from the neck of a dog in Sussex, when gorged with blood and swelled out in the above-mentioned manner, I send you for your inspection.

It appears that the celebrated Lyonnet, during one of his entomological excursions, was attacked by a similar insect, but which he unfortunately broke, so firmly had it fixed itself, in endeavouring to extract it; and he was in consequence obliged to lay open the place in order to extract the proboscis, which being the part broken off, had remained in his flesh, lest an abscess should have been formed in his leg. But the worst of all the tick tribe of insects is the American one, the *Acarus Americanus*, described by Professor Kalm. This insect is found in the woods of North America, and is equally an enemy to man and beast. They are there so exceedingly numerous, that if you sit down upon the ground, or upon the trunk of a tree, or even walk with naked feet or legs, they will cover you; and, plunging

their serrated rostrums into the bare places, begin to suck your blood, continually going deeper and deeper, until they are half buried in the flesh ! Though at first they occasion no uneasiness, yet, when they have thus once made good their settlement, they produce an intolerable itching, followed by acute pains and large tumours. It will now become extremely difficult to extract it, the insect rather suffering itself to be pulled to pieces than to let go its hold ; so that its rostrum and head being often left in the wound they produce an inflammation and consequent suppuration, which render the wound deep and dangerous. These ticks are also at first very small ; but, by suction, they will swell themselves out till they are as big as the end of one's finger, when they often fall to the ground of themselves. The serrated *hastellum* of the tick, which, like the barbed darts of a bee, cannot be extracted without the co-operation of the insect, is well worth your inspection ; for which purpose I send a few specimens. Kalm affirms that they frequently attack the horse, and that he has seen the under parts of the belly and other parts of the body of that animal so covered by them that he could not introduce the point of a knife between them ! They were deeply buried in the flesh ; and in one instance that he witnessed, the miserable creature was so exhausted by their continual suction that it fell, and afterwards died in great agonies.

I also send you a couple of ticks which I took from a nightingale. These minute insects have strong double claws, and a rostrum somewhat like the dog-tick. In endeavouring to take them from the skin of the bird, I found that they had so deeply buried their instruments that one of them broke off, and the other I pulled out with great difficulty. You will observe that it was furnished with coarse teeth, like a saw, on each side, and which are damaged in pulling it out ; there are some very curious markings on the skins of these insects.

I likewise send you a couple of ticks taken from a duck,

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of a very singular appearance ; as also several which I found upon a fowl, and of different species. This fowl was in a most miserable state from the annoyance of these tormentors.

With these you will also find several ticks which I found on the bodies of bees and flies, and which are of very curious forms and characters.

I also send you two ticks of a very singular shape and appearance, which I found running among the hairs of a bat. They are so different in shape from most other insects that they deserve your most minute examination, and particularly the markings in the skin of their bodies. As Baker has mentioned this insect, and given three figures of it in his work "Employment for the Microscope," page 406; and that book being in your possession, I must refer you to it for a more detailed account of this very curious insect.

With these insects you will likewise receive a slider containing a piece of skin taken from the bat, with some hair attached to it of a singular structure ; and also a small portion of one of its very fine wings, in which you will observe a curious granulated structure.

I likewise send you a few insects which are covered over with very minute ticks ; these seem to be firmly attached to the bodies of the insects by means of singular thread-like appendages, which bind them together in clusters.

In examining some minute seeds, I found among them several curious mites, or minute ticks ; one, which I found among the seeds of the catch-fly, I send you ; and also one of a very singular form that I took out of the seed of the rose campion ; together also with a third species which I found among the poppy seed ; and as this last had very curious feelers at its head, furnished with sharp cutting fangs, I have pressed some of them very close between slips of glass, in order for you to use a deep power object-glass in viewing them. One of these insects you will also find placed between talcs, in a very perfect state.

I also send you several very minute *acari* which came out of the eggs while in my possession. These eggs I found in a very singular situation. During the building of Waterloo bridge I was examining a piece of the granite stone, which was about three or four inches square, and was much surprised at seeing nearly the whole surface of it covered over with minute white eggs. I was at a loss to conjecture for what purpose the parent insect could have deposited them in that situation, there being no appearance of any sustenance for the young when excluded from the eggs. However, in order to ascertain whether any living creatures would come forth from these exceedingly minute specks, I took the piece of stone home with me, and placed it within a large glass tumbler, which I covered close over with paper, perforating the paper with a fine needle. In about a week I observed multitudes of *acari*, of a dark red colour, running about within the tumbler; these I put into a pill-box, and which I now send to you, with the piece of stone covered with the shells of the eggs from which these minute creatures came out.

Before I conclude, I take the liberty of recommending to your microscopic readers to select and examine some of the most minute seeds; they will furnish them with some interesting microscopic objects in the curious markings on their surfaces, which are exceedingly beautiful when viewed as opaque objects. I herewith send you half a dozen specimens of small seeds for your examination; some of the larger kinds will also afford much delight in examining and dissecting them; as in many of these the future plant or tree may be seen. Of this we have plenty of proofs in the works of men celebrated for their microscopical discoveries.

Thus far, however, our sight, assisted by the microscope, is, at any rate, able to discover, that Nature in her operations is in nowise confined to our conceptions of greatness, but that she acts as freely in the minute fabric of a mite as

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in the bulky compass of a whale or elephant ; nay, that she rather seems to extend her skill, by giving a greater number of limbs and more numerous ornaments to the minute creatures than to the larger ones.

I am, dear sir,

Your obliged friend,

To T. GILL, Esq.

THOS. CARPENTER.

*Remarks by the EDITOR.*

In plate V. fig. 7 represents one of the shorter scales of the *Papilio Cethosia Julia*, and fig. 8 one of the longer ones ; their external ends being singularly fringed. Fig. 9 exhibits the curious crossing of other scales upon the wings of the same butterfly ; the lower layer being composed of lighter coloured oval scales, and the upper one of yellow ones, with an indented margin. This crossing of the scales, as well as the forms of those shown in figs. 7 and 8, are quite new to us.

The first kind of *dermestes* mentioned by Mr. Carpenter, are similar to that mentioned in our first volume, page 79, and their exuviae abound with the very curious and beautiful compound hairs, figured in plate III. of that volume, and to which we must refer our readers. But the exuviae of another species, mentioned by him, are much longer, and of a quite different form ; and, besides abounding with the two kinds of compound hairs above-mentioned, have likewise scales similar to that shown in fig. 10 of plate V. ; their upper ends terminating in sharp points, and their lower ones being furnished with short stems, by which they are affixed into the skins or exuviae. But the exuviae of the *dermestes* found under the bark of the sallow abounds in compound hairs of very different forms from any of the above. Fig. 11 exhibits one of the shorter ones ; and fig. 12 one of the longer kind, and which are singularly curved or hooked at their outer ends.

Fig. 13 of plate V. represents part of the coat of a seed

of the batchelor's button, a common field-flower; but which, when viewed as an opaque object, under highly-magnifying powers, presents a very singular and beautiful structure; so also does that of the seed of the scarlet lichnis, shown in fig. 14, under similar circumstances.

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### XLVIII.—On the Nitrates.

(Continued from page 250.)

*Nitrate of copper.*—It is sufficient, in order to obtain this salt, to place plates of copper in nitric acid, diluted with three or four parts of water, in order to prevent a too violent action. When the solution is effected, it is left to settle for some time in a tall and narrow vessel, it is then decanted, and evaporated to a syrupy consistence, as the salt is highly deliquescent: we thus obtain fine and long parallelopipedons, of a clear blue colour; but which are, as above stated, very deliquescent.

The deutonitrate of copper is employed in some calico printing works as a red.

If we decompose this salt by heat, we obtain the deutoxide of copper in a state of purity, a product which is now much used in the analysis of organic substances. The deutonitrate of copper is also used to make *cendres blues*.

This salt is composed of

Nitric acid . . . . .	57.74
Deutoxide of copper . . . . .	42.26

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100.

*Nitrate of tin.* (Or the protonitrate.)—This salt has such an avidity for oxygen, that is difficult to unite its protoxide with the nitric acid, and also to maintain the combination of the two bodies; nevertheless, as it is used in some dye-houses, we shall indicate the means of obtaining it. We bring the acid into contact with the tin in a laminated

state, or in the form of ribands, the acid being previously diluted with water until it marks about  $4^{\circ}$  or  $5^{\circ}$  of the areometer. [We leave it to act for several days, having carefully enclosed it in a well-stopped vessel. By degrees the metal passes into a protoxide, which dissolves without the extrication of much gas; but we afterwards find nitrate of ammonia in the liquid, and which we suppose has been formed thus:—Part of the oxygen has been furnished by the water, and another part by the nitric acid, when completely decomposed; this afterwards becomes mixed with azote, and which finally unites with the hydrogen, to form the ammonia.

We can obtain the protonitrate of tin more pure and concentrated, by bringing the protoxide into immediate contact with the nitric acid, largely diluted; but this process requires that we previously prepare the protoxide, which complicates the operation. Nevertheless, if we would employ this mode, we take the ordinary salt of tin (the protochlorate of tin) and dissolve it in water; we then filter it, and add ammonia in a slight excess to it: we thus form an abundant white precipitate, which is the hydrate of the protoxide; we then submit the mixture to ebullition. The precipitate changes its colour; it becomes at first gray, and then black; it acquires more cohesion, and is deposited more readily: it is now deprived of the water of combination which it contained. We suffer it to cool, wash it by decantation, and leave it to dry.

We do not prepare more of the protonitrate of tin at once than we require for use, as it readily decomposes. We find, in fact, that at the end of a short time, it forms a gelatinous deposit, which is nothing else than the sub-protonitrate.

The protonitrate of tin is employed with advantage in dyeing scarlet. M. Chevreul says that it may also be employed with success in the preparation of the purple precipitate of Cassius.

*Nitrate of iron.* (The trito-nitrate.)—To procure this

combination, we boil the rust of iron in a dilute nitric acid, until the solution will no longer be precipitated by the red ferrocyanuret of potassium.

M. Vanquelin has obtained this salt in the form of white quadrangular prisms, terminated by sharp edges at their ends. These crystals are highly deliquescent, and furnish a red solution in distilled water.

The tritonitrate of iron is employed in dyeing, to give to cotton a nankin colour.

M. Remond, of Lyons, recommends it, as being capable of affording the finest Prussian blue that can be made; but other manufacturers contradict this assertion.

*Nitrate of mercury.*—As there exist two oxides of mercury, so likewise are there two nitrates, both of which are employed in the arts: we shall now indicate the means of obtaining them. It is very difficult, nay we may say impossible, to procure at will the protonitrate, which nevertheless is the most frequently required; but as the two salts possess different degrees of solubility, so they can be readily separated by crystallization. We take one part of mercury, and three of the nitric acid, diluted from 20 to 22 degrees; we put the diluted acid into a matrass, and heat it, in order to facilitate its action upon the mercury, which we put to it by degrees, in proportion as it dissolves, in order to maintain the solution at the *minimum*; after a sufficient time has been allowed we suffer it to cool. We then see deposited at the bottom of the vessel crystals, in the form of irregular polyhedrons, with brilliant facets; which, however, are in a certain degree opaque, and become more and more voluminous.

When we design to obtain immediately a large quantity of the protonitrate of mercury, the method we have above indicated becomes too tedious, as the re-action is slow, and would occupy too much time; and we are therefore obliged to employ instead thereof, that process which is followed in the great laboratories. Thus we pour upon one kilogramme

of mercury,\* 1500 grammes † of the ordinary nitric acid, and we repeat this quantity, but placed in separate vessels, according to the quantity of the protonitrate which we would obtain. By thus dividing it we avoid that too violent action which always tends to unite the crystals into considerable masses.

The solution is generally effected in a few hours; it contains a mixture of the proto with the deutonitrate of mercury. At night, or next morning, there will form in each vessel a certain mass of crystals, which are sometimes indeed large and adhering to each other; but more frequently they are in the form of long prismatic needles, and are entirely composed of the protonitrate; we then decant all the liquid portions, and drain the crystals completely therefrom; these we afterwards unite and dissolve anew in water slightly acidulated. It is with this liquid that we prepare the protochloruret of mercury, or what was formerly termed the *white precipitate*, as well as all the other compositions which require the use of the protonitrate.

With respect to the mother-waters of the first solutions, we evaporate them to dryness, and then submit the residuums to a calcination in glass vessels, in order to obtain the *proxide of mercury*, or the *red precipitate*.

The protonitrate of mercury is but little soluble in water. This solution properly constitutes the *mercurial water* of the apothecaries. Nevertheless, they also give the same name to water when simply boiled with mercury; and which is administered to infants as an athelmintic.

The protonitrate of mercury, and especially those crystals of it which are the least compact, quickly alter on exposure to the open air; they become yellow on their surfaces, and are converted into a sub-deutonitrate.

The solution of the mercurial protonitrate is precipitated

\* The killogramme is equal to 2lbs. 3 oz. avoirdupois.

† The gramme is explained in the sequel of this article.

black by caustic potash or soda; and of a grayish-black by ammonia. This last precipitate is a double salt, known by the name of *Hanneman's soluble mercury*.

The protonitrate of mercury contains, according to Berzelius,

Nitric acid . . . . .	20.47
Protoxide of mercury . . . . .	79.53
	<hr/>
	100.

The deutonitrate is only employed in its state of purity as a re-agent, and the most certain mode of obtaining it for this purpose, is by directly combining the deutoxide with the nitric acid. This salt, which is much more soluble than the protonitrate, crystallizes in small needles; its solution is precipitated of a yellow colour by the caustic alkalies: ammonia however forms with it a triple salt, which is white.

The deutonitrate, when dissolved in a large quantity of hot water, is decomposed; and forms a sub-deutonitrate of a yellow colour, the *nitrous turbith* as it was formerly termed; and the nitric acid which remains in the solution. The above liquid does not precipitate by the addition of the hydrochloric acid, or the hydrochlorates.

The deutonitrate of mercury is composed of

Nitric acid . . . . .	33.15
Deutoxide . . . . .	66.85
	<hr/>
	100.

The sub-deutonitrate of

Nitric acid . . . . .	11.03
Deutoxide . . . . .	88.97
	<hr/>
	100.

In most of the cases in which the nitrate of mercury is employed, we make use, as we have above observed, of the mixture of the two salts which results from the direct action of the ordinary nitric acid upon mercury. It is thus

that we prepare the red oxide of mercury, the *pommade citrine*, and the mercurial liquid employed by M. Poutet, of Marseilles, to ascertain the purity of olive oil; it is also the secret employed in fitting hair for the felting process.

*Nitrate of lead.*—A great quantity of this has been manufactured for several years past, as it is not only employed in calico-printing, but also in the making of chrome yellow.

They formerly used the acetate of lead; but besides the difference in price, they were not long in giving preference to the nitrate, which furnishes more satisfactory results in respect to the colours.

In order to obtain the nitrate of lead, they commence with diluting the ordinary nitric acid, by adding two or three parts of water, heated to  $60^{\circ}$  or  $70^{\circ}$ ; this mixture is put into an earthen vessel, and placed in a water-bath; they then add by degrees pulverized litharge, until they have attained a complete saturation. Arrived at this point they suffer the liquid to deposit or settle for a few moments, and then decant it into another earthen vessel previously heated. They then repeat this operation until they have employed all the litharge which they intend to convert into the nitrate. All the liquors are then united in one vessel, and suffered to become completely cold: this of course requires a greater or lesser time to accomplish, according to the quantity of liquid, and to the prevailing temperature. They then draw off the liquid by means of a leaden syphon, and form the first crop of crystals; they wash these with the clear mother-waters, as well also as those salts which are deposited in the usual form in the lower part of the vessel. They put the chief part of these crystals to drain upon a sieve, and the remainder they return, either into the earthen vessel, to dissolve in the heat of the water-bath; or still better in a boiler of platina. But they avoid the employment of leaden vessels, because, instead of the liquor becoming neutral, it re-acts upon the lead, and forms an hyponitrate of lead, which is yellow, and communicates that colour to the crystals of nitrate of lead; an

inconvenience which would prejudice its sale, as the consumer requires it to be of a fine white colour.

After obtaining several crops of crystals, the mother-waters become green, owing to the French litharge containing a quantity of copper. We may separate the principal part of this copper, by suffering the mother-waters to remain in contact with plates of lead for several days in the cold. But notwithstanding this precaution, the nitrate obtained from these mother-waters is never fine, and we are therefore obliged to dissolve and crystallize it anew.

Besides the copper, our litharge likewise contains other foreign matters, which will not dissolve in the dilute nitric acid, and particularly the arseniate, phosphate, and sulphate of lead, which it owes to the calcination of the arsenic, the phosphorus, and the sulphur contained in the ordinary lead. We also find in the residue the earthy substances from the bottoms of the furnaces, and which are introduced into the litharge, in the course of the manipulations by which it is formed. All these bodies constitute a magma or residuum, which prevents the dilute nitric acid from dissolving all the oxide of lead remaining interposed between its parts; and therefore, when we have sufficiently washed this residuum, we are obliged to reject it as useless. Nevertheless, it ordinarily retains some portions of silver, which might be extracted by fusion in the melting furnace.

The nitrate of lead, when prepared in the large way, crystallizes in beautiful octahedrons, of a dead white colour. Fourteen parts of it require one hundred of water to dissolve them at the ordinary temperature. It is formed of

	Thomson.	Chevreul.	Berzelius.
Nitric acid . . .	34 . .	33 . .	32.69
Yellow oxide . . .	66 . .	67 . .	67.31
	<u>100.</u>	<u>100.</u>	<u>100.</u>

It has been proposed to employ this salt, in the prepara-

tion *des mèches d'artifice*, because they would keep better than when made as usual with the nitrate of potash.

*Nitrate of potash.*—This species of salt, as we have before observed, is the most important of all the nitrates ; it is naturally furnished in great abundance, and of course is the better known ; and it thus deserves, in every respect, to have its history given in detail.

It has been successively named saltpetre, nitre, salt of nitre, and nitrate of potash. And although it had formed the especial object of study with a great number of individuals, yet it was not until the period of the establishment of the pneumatic doctrine, that we could appreciate and comprehend the singular phenomena which it presented. We knew indeed beyond a doubt, that saltpetre contained within itself the principle of combustion, and advantage had been for a long time taken of this property ; but the true nature of this principle was unknown. Until the discoveries made by Lavoisier, nothing but plausible explanations of this wonderful phenomenon were afforded. This illustrious academician was the first who proved the perfect identity of the vital air of our atmosphere with the principle that supported combustion in the nitre. He showed on the other hand, that one of the two principles which formed the essential basis of our atmosphere, but united in other proportions, also constituted the acid of nitre ; this similitude of a composition so remarkable, is beyond doubt one of the causes which favours and determines the spontaneous formation of nitre ; but of the existence of which combination, now so precious to us, we were before absolutely ignorant.

Saltpetre is spontaneously formed in different countries, such as Spain, Egypt, and especially in India, whence it may be had in such great abundance as to be sufficient to supply all Europe. But, in other countries, our's for instance, saltpetre is more rarely to be found, although its essential principles are produced in abundance, and it only remains for us to choose among them those which are fittest to accomplish the work of forming it. Lastly, if the

soil be less favourable to the formation of this salt, or, as we may say, presents no appearance of it; but, as, nevertheless, to be independent of others is one of the principal wishes of every people; so, it is natural in their own defence, that they should be compelled to unite artificially the materials judged to be necessary for the production of saltpetre.

We shall indicate, in succession, the different processes employed to collect or produce the nitrate of potash, before proceeding to make known the theoretic principles upon which we conceive the spontaneous formation of this salt depends.

In India, in South America, and in some parts of Spain, the earth naturally abounds in saltpetre; and thus, in certain seasons, it rises to the surface of the soil, either in the form of small silky tufts, or in prismatic crystals. This phenomenon is the more remarkable when the heat is sufficiently great, and especially after the fall of showers of rain; and we can readily conceive that this will be the case, when we suppose that the soil being impregnated with saltpetre, the rain-water dissolves it, and slowly raises it to the surface of the earth, when the continued heat reduces the humidity into vapours.

This saline efflorescence is usually collected simply by the aid of brooms or brushes; from whence it receives the denomination of saltpetre sweepings. We are ignorant whether the East-Indian nitre is produced in this way; but it is certain that the crystals of it are, in general, small and short. This natural nitre is the more valuable, as it is nearly pure; the best quality of it losing only from three to four per cent. in the proof. We shall hereafter describe the method of assaying it.

In France the nitrate of potash is but rarely found, and in too small quantities to enter into account; but, instead thereof, we have the nitrates, whose bases are lime and magnesia, and which, being very soluble, and consequently less susceptible of crystallizing, remain in the saltpetre earths,

provided that they be in sufficient quantity to retain the solution. Now it is evidently easy to substitute potash in the place of the bases naturally combined with the nitric acid ; and thus to obtain in consequence a true nitrate of potash. We shall now show the means necessary to be employed in order to obtain this end ; and shall commence by observing, that this operation, which at first sight appears to be an abundantly simple one, is, nevertheless, sufficiently complicated, owing to the other salts which also accompany the materials necessary to form the saltpetre, and the freeing it from them offers more or less difficulty, according to their abundance, and their relative proportions : thus, there are not only the nitrates of potash, of lime, and of magnesia, but likewise, the hydrochlorates of the same bases ; and besides these, also common salt, sulphate of lime, colouring matters, &c. It therefore becomes necessary to make a sort of *parting* of all these products, and, in consequence, to undertake the series of operations which we shall describe, and which, indeed, constitutes the art of saltpetre making.

The first care of the manufacturer of saltpetre is to know the riches contained in the materials upon which he proposes to operate, in order to ascertain whether they merit his trouble ; and in this he has no other guide than habit. He does not employ any precise method, but is contented with merely tasting the materials, and judging of their value, from their saline savour possessing a sharpness and bitterness more or less distinct. It would, nevertheless, be easy to acquire more certainty in this respect by dissolving or washing a small portion of it, and ascertaining by the product of the evaporation the quantity of the saline matters it contained. For the rest, whatever be the method employed to determine this richness, when it is ascertained, he proceeds to wash the materials ; but we conceive that this washing would be greatly facilitated were the materials to be more completely divided. He commences then with pulverizing the larger parts, either by the strength of men,

or the aid of machinery ; and passing the whole through a hurdle or coarse sieve. When he has thus provided a sufficient quantity, he distributes it into ordinary tubs, placed in three rows. These tubs have additional bottoms to them, filled with holes, raised a little above the others, and being placed on a level, are fitted underneath with transversal staves, between which is deposited a bed of straw ; there is lastly a tap fitted into the lower part of each tub, to draw off the liquid. Each tub being so prepared, they are placed so that their taps may all discharge into a common channel or gutter, which communicates with a reservoir. When all is ready, they fill up the tubs with the prepared materials, and pour as much water as they can hold into the three vessels forming the first row. After about twelve hours have elapsed, they open the plugs of the taps, and suffer the liquid to flow off into the reservoir. They then again close the taps, and proceed in the same manner to give the materials a second washing ; but only suffer the water to remain for three or four hours. Finally, they also make two other washings, but these are received into a second reservoir ; they then replace the washed materials with new ones.

When they have thus exhausted the first row, they proceed to the second ; but here, instead of employing pure water they use that of the two first washings, and which had been received in the first reservoir, and pass it successively through the new materials until it will mark from 12 to 14 degrees of the areometer for salts, when it will have become sufficiently rich to be evaporated ; and they add to it, by degrees, all such as shall have thus become sufficiently strong. They distinguish these washings by three different denominations, thus :—they name *eaux de cuites*, those which are ready for evaporating ; and which, as we have before said, mark from 12 to 14 degrees of the areometer. They term those the *eaux fortes*, which mark less than four degrees ; and, finally, the *petites eaux*, those

which only indicate from one to two degrees ; and they follow this order in their work, that the first washings are always made with the stronger waters ; the second with the weaker ones ; and the last with pure water. This method is equally used in every case of this kind.

We have before said that the major part of the nitrates contained in our saltpetre materials have bases of lime and magnesia, and that we are obliged to substitute potash for them ; but there are many ways of doing this. The most simple and direct, but also the most expensive, consists in adding to the *eaux de cuites* the sub-carbonate of potash, which we procure either by washing wood-ashes, or employing the potash of commerce. The lime and the magnesia combine with the carbonic acid, and form sub-carbonates ; which, being insoluble, precipitate, and the potash replaces their former combination with the nitric acid. When this operation has been well conducted there remains only the nitrate with a base of potash.

As the relative prices of saltpetre and potash, however, will not permit us to have recourse to this means, we are obliged to search for more economical ones. Those which are of the most facile execution consist in employing the sulphate of potash, which may be had at a very low price, it being the residuum of the manufacturers of the sulphuric and the nitric acids. But, it is to be remarked, that this salt does not entirely fulfil all the necessary conditions, because it does not decompose the nitrate of lime, and its action upon the nitrate of magnesia is not always sure, as the sulphate of magnesia which is the result, is soluble ; and we are thus obliged, in employing this process, to first convert the nitrate of magnesia into nitrate of lime, by adding to the washings sufficient lime to separate all the magnesia. We then add a concentrated solution of the sulphate of potash, having care, also, according to the quantity of the alkali which it contains, to add 100 parts, or never less than 79.3 of the sub-carbonate of potash ;

and which will thus produce a sulphate of lime which is less soluble, and consequently more readily separable than the sub-carbonate of lime.

As the sulphate of potash obtained from the manufacturers of the sulphuric and the nitric acids always contains a slight excess of acid, so it is indispensable for the above purpose to previously saturate it with a little lime.

We may also employ a third method, which answers a similar purpose with the preceding one, but with the advantage of using salts, which are frequently only an incumbrance to the manufacturers. Thus we make a mixture of 93 parts of hydrochlorate of potash, and 89 of sulphate of soda, and thereby produce sulphate of potash and muriate of soda; and as these are both soluble salts, so they will not appear at first. Nevertheless, when we add this mixture to *l'eau de cuite*, to which we have previously added a little lime-water, they simply change to sulphate of potash, but with this difference, that muriate of soda is also formed, which remains in the solution.

When the *eaux de cuite* are found to contain no other nitrate than that of potash, we submit them to evaporation in a copper boiler, the furnace of which is constructed in such a manner as that the heat which escapes from it shall also heat another vessel, into which is put another portion of the same *eaux de cuite*, intended to supply the boiler by means of a cock; and which is so regulated as to supply the boiler with more liquid, in proportion to the evaporation from the boiler. On the other hand, we must also supply this second vessel with more of the *eaux de cuite* to replace those which have run into the boiler.

We increase the heat so as to produce ebullition; and when this takes place a scum is formed, which must be removed and deposited in a vat placed above the boiler, and furnished with a cock, by opening which, the scum can be drained. In proportion as the evaporation proceeds, the carbonates of lime and magnesia are deposited, unless, indeed, we have employed the sub-carbonate of potash in place of the

sulphate of lime. The greater part of this deposit is collected in a vessel placed at the bottom of the boiler, and which may be removed at any time by means of a cord passing over a pulley. This is raised up whenever we judge that it is filled ; but we must not cease to replace it when we perceive that the muriate of soda also begins to be deposited. As this salt has the property of being more soluble in hot than in cold water, so it continues to crystallize during the whole period of the concentration ; it is removed as fast as it forms itself, by means of a scummer, full of holes, and deposited in a basket, which is placed above the boiler in order that the liquid may drain from it into the boiler. When the liquid has attained the strength of 80 degrees of the areometer, the fire is withdrawn, and it is suffered to deposit for several hours ; then, with a leaden syphon, the shorter branch of which is plunged to the bottom of the water, the liquid is drawn off into a wooden vessel ; we finally transfer this liquid into copper or iron basins, which are placed in the open air, in order to promote the crystallization. When this is effected, and the cooling is complete, we decant the mother-waters and drain the crystals ; we also wash or sprinkle them with a little cold water, and, in some manufactories, the rough nitre is placed in wooden hoppers, where it is repeatedly washed with small quantities of cold water. It is thus deprived of the greater part of the foreign salts which it contained, and which are soluble in the cold. The reverse effect, however, takes place in a more elevated temperature ; and this difference of solubility by heat enables us to extract the small quantity of nitre which the muriate of soda retains that was separated during the concentration. The quantity thus obtained is generally about two parts in the hundred, and to separate it, we mix the muriate of soda, which always contains a little muriate of potash, with about a fourth-part of its weight of water, heated to 50 degrees. After having well stirred this mixture, we suffer it to drain ; and in this case all the nitre is held in solution,

but it brings off with it nearly the fifth-part of its weight of marine salt. The washings are afterwards added to the *eaux de cuite*.

We likewise add the first mother-waters and washing-waters to the *eaux de cuite*, and never omit this until they become too much coloured, and so viscid as to hinder the crystallization of the nitre.

Such is, in substance, the process which was proposed by the Consultative Committee of the gunpowder and saltpetre works in France, in the year 1820; but, as every master follows the method which is most convenient to him, and employs those processes that are suggested by his experience as well as his interest, and as, on the other hand, Government reserves to itself the monopoly of the purification of this salt, in order to guard against having a badly-manufactured article imposed upon it; the Administration was obliged to search for the means of keeping accounts with the manufacturers of the real quantities of nitrate of potash which were contained in the rough saltpetre which they sold to Government; and to obtain which, they proposed different methods. The most generally known one is that which was suggested by M. Riffaut, and which is founded upon the solubility in water saturated with pure nitre of the other salts which accompany the rough saltpetre. This is the method followed:—

They take pure nitre, pulverized, and mix it with one part and a half of water, at a temperature of thirty degrees\*, and let it cool completely, and they thus obtain a liquid saturated with nitre at the ordinary or surrounding temperature; but they take care that this temperature continues the same during the whole time of making the essay. They then put into a vessel 400 grammes† of the

\* Of the centigrade thermometer, equal to 86° of Fahrenheit.

† The gramme is equal to 15.4440 English grains.

saltpetre they would test, and add to it a demi-litre\* of the water saturated with nitre; they then stir or agitate it from fifteen to twenty minutes, and decant the liquid part into a funnel, furnished with a filtering paper. They then pour again upon the saltpetre two décilitres† and a half of the water saturated with nitre, and agitate it for a quarter of an hour; they then pour it upon a filtre, and leave it to drain. They afterwards take hold of the pipe of the funnel with the right-hand, and gently tap the exterior of the paper filtre with the left-hand, in order to detach it from the funnel. When they have thus carried this slight tapping all around the circumference of the paper filtre, they gently place the upper border of it upon a leaf of blotting-paper, folded in four, and held in the left-hand; then, by an horizontal and quick movement, suddenly stopped, of the right-hand which holds the funnel, they cause the filtre to separate from the funnel, and deposit it upon the blotting-paper. They then enfold and wrap up this paper in several more papers of the same kind, in order to abstract the moisture quickly; and they renew the enfoldings so long as any moisture remains. When the paper filtre is thus strengthened by drying, they can proceed to unfold it without risque of breaking it. They then extend it upon a new leaf of blotting-paper, and leave it to dry for twenty-four hours; after which time, they carefully remove the salt from the filtre and put it into a glass bottle, which they finally place upon a sand-bath. They then slightly heat it, and when the nitre has become so dry as no longer to adhere to the glass, they remove it, and take the weight of it, and subtract the weight of this pure nitre from that of the rough saltpetre employed; when they thus ascertain the loss experienced in the proof. But they also add to this loss two per cent. in the quantity of eight

\* The litre is nearly two-and-a-half English wine pints.

† The décilitre is equal to 6.10244 English inches.

grammes, in order to compensate for the portion of pure nitre left in the saturated water, and also for certain insoluble matters which are always found in the rough salt-petre.

This process requires a certain degree of dexterity on the part of those who employ it, otherwise they will be liable to commit errors which may prove highly prejudicial to the parties interested. Thus, for instance, they ought to be perfectly certain of the exact saturation of the proof liquor if they would avoid the loss of a portion of the salt-petre subjected to the essay ; and this is a fault which they may easily commit in the ordinary way of business ; as they consider that as a perfectly saturated solution which may have remained for a longer or shorter time with an excess of nitre in it ; as, without paying attention to the lowering of the temperature, or to the molecular attraction, the liquor may appear to have a degree of purity greater than that acquired by the actual temperature. It is therefore indispensable not to make use of it the moment it is made, but to employ that only which has been subjected to a variety of temperatures ; but this is a particular, which, in general, is never attended to. There is also another difficult point to be attended to, and this consists in so elevating the temperature of the solution, as that the salt shall remain incorporated with it, without allowing it, by evaporation, to deposit a portion of what it contained. Finally, the degree of dessiccation at which it is convenient to stop, merits the greatest attention ; as the rough salt-petre, that of India, for instance, is liable to contract a certain degree of humidity, which it is necessary to rectify. We ought therefore to commence by determining the quantity of humidity contained in the specimen we would essay.

*(To be continued.)*

XLIX.—On Opium, Morphium, and Narcotine\*.

THE opium of commerce is a brown extract which is procured from the white poppy, the *papaver somniferum*, of Linnæus; a plant which is cultivated especially for this purpose, in the East Indies, Arabia, and Persia; but that furnished from different countries, whether owing to the influence of climate, or to the modes of preparing it, varies greatly in its qualities, and is not therefore estimated at the same price by the druggists.

It appears from the accounts of travellers worthy of credit, that the opium mostly used by the Orientals, is obtained from incisions made in the capsules of this poppy. This is performed when the plant is in its most succulent state, and before the capsules turn yellow; at this period of the maturation, the incisions are made of but little depth, and milky drops flow from them, which have a strong smell and a bitter taste; these become coloured, and acquire more and more consistency from the contact of the air; and after being exposed to its action for ten or twelve hours become solid. They then remove this first formation of opium, and proceed to make new incisions; and which they repeat, until they have drained or exhausted the whole periphery of the capsules.

The opium which is thus spontaneously produced, is naturally that which is most sought after; and we distinguish that in commerce as being of the first quality, which the Turks term *affion*, or the *mother-drops*, because they are usually divided into small portions, and enclosed within papers which are slightly oiled; and they thus assume in some degree the forms of drops or pastilles.

It does not, nevertheless, appear that this opium of the first quality is consumed in those countries; at least it is generally said, that a part of it is reserved, to be added to that which is of an inferior quality, in order to give it that

\* From the *Dictionnaire Technologique*.

strong odour, which forms one of the essential characters of good opium. Thus, when the gathering of the opium from the capsules is completed, they collect the stems, and bruise them, together with the capsules, and extract their juice, which they keep apart; they then mix the dregs with a certain quantity of water, and make a decoction, which they pass through a sieve, or squeeze through a cloth, and lastly submit to a careful evaporation. When the decoction is thus reduced to about a third part, they add the expressed juice to it, and again evaporate it, until it acquires the consistence of an extract; and they then incorporate with it the natural extract, which they had procured from the incisions made in the capsules. They form, with the extract thus prepared, small round masses, which they sprinkle over with the leaves of the poppy, grossly powdered; and also with the waste of other vegetables, and especially with the seeds of a rumex; and indeed these are often incorporated, in considerable quantities, with the masses of opium; finally, they complete the drying of this extract in the sun. This appears to be the most rational and probable account of the fabrication of the oriental opium.

We should choose opium in small masses, well dried, and breaking with a neat and homogenous fracture, of a reddish-brown colour, and of a strong odour, but without any mixture of empyreuma. When of a good quality it easily softens when pressed between the fingers; and it is susceptible of inflaming when brought near to the flame of a candle: but the best means which we can take, in addition to these characters, to be assured of its quality, is to determine, by experiment, the proportion of soluble matter which it contains.

The eminent rank which opium holds in medicine, has at all times rendered it the object of attention to practitioners, a great number of whom have made it their especial study, and always with the intent of discovering its active principle; but which they have, in turn, made to

reside in products of very different natures. Notwithstanding this, we have at length acquired positive data respecting the nature of this valuable remedy. In the year 1803, M. Derosne, a distinguished apothecary at Paris, published an excellent Memoir upon this subject, and which was also inserted in T. xlv. of the *Annales de Chimie*. It appears from this work, that there exists in opium a particular crystalline matter, which is readily obtained, by exposing to spontaneous evaporation, a maceration of opium made at first in the cold; but which is afterwards concentrated by the aid of a gentle heat, to the consistence of a thin syrup. The crystalline matter which thus separates, also entangles with it, on precipitating, a certain quantity of brown resin, but from which it may be purified by new solutions and crystallizations, with the intermediation of alcohol; and when it is entirely freed from the foreign matters, it is perfectly white, brilliant, and has a satiny appearance; it assumes the form of long needles, or flat prisms; it is insoluble in pure water, but dissolves in great abundance, by the addition of a small quantity of acid; and when saturated with this acid, it is completely precipitated, and re-produced with all its primitive characters.

This remarkable substance also enjoys the property of melting without being decomposed, when exposed to a sufficient, but moderate heat; and it preserves that transparency after cooling, which it had acquired from this liquefaction. When subjected to a more elevated temperature, it burns with a flame, and diffuses around the smell of haw-thorn blossoms, if exposed in contact with the air; but if placed in close vessels it is decomposed, and affords azotic products. Such then are the characteristic properties of this substance, and which was for a long time known under the denomination of *sel de Derosne*. Nevertheless, this author has given to it other properties, which he attributed to a particular modification. Thus, he said, that upon adding carbonate of potash to an aqueous solution of

opium, we obtain a precipitate, which, when treated and purified with boiling alcohol, produces a substance analogous to the preceding; but which possesses the remarkable property, probably owing, as M. Derosne says, to the alkaline precipitant; of turning the syrup of violets green. Thus we see, that he missed the opportunity of making an important discovery, by trusting too much to the rule of analogy. It is indeed generally true, that a body precipitated by another, carries down with it a portion of the latter in combination with it; but this rule is not always constant; and M. Derosne should not have come to this conclusion without farther examination. Thus we see how necessary it is, in chemistry in general, not to reason too much from analogy; but to reckon nothing as a decided fact which has not been demonstrated by experiment. What will they say then, when they learn that he had no foundation for forming such an opinion, but must come to the same conclusion as that formed by M. Sèguin; since this chemist not only saw, as M. Derosne did, that his crystalline substance was precipitated from an aqueous solution of opium by alkalies, but he also found that it constantly preserved its alkalinity; and that it likewise dissolved completely in acids, whilst it remained insoluble in alkalies; he has elsewhere described its other properties. It was however then too early to suppose that there existed organic alkalies, that idea did not present itself, notwithstanding the evidence of facts; and it was reserved for M. Sertuerner to perceive and to make known this important fact, and which has since become the only source of interesting discoveries. He was indeed the first to announce to us that the active principle of opium was a substance, which although of an organic nature, was also alkaline; and that it was susceptible of uniting with acids, of becoming saturated therewith, and of forming true salts with them, in the ordinary manner of alkalies; and also that this new principle, which he termed *morphine*, was

naturally combined with an acid, to which he gave the name of *mèconique*. But this able chemist, who has proved to us how necessary it is to the science, to prevent all chance of mistaking the real truth, from the mere appearance of it, instead of endeavouring to defend this species of combination, and striving to generalize his discovery, by terming the salt of Derosne a *mèconiate* of morphium, was too good an observer to be mistaken on this point; and he found it easy to show, by a course of new experiments, that the crystalline matter, which spontaneously deposited itself in the concentrated solutions of opium, differed essentially from morphium; that it neither partook of the nature of acids nor of alkalies; that it indeed dissolved in acids, but not to saturation; and that it was in fact a particular principle, to which he gave the name of *narcotine*. Thus we see that there are three different bodies well characterized, which exist in opium, and form the essential basis of it. We might indeed point out many others also, but as they do not possess the same degree of importance, we shall not describe them here, but proceed to indicate the course which must be followed in order to separate the above three bodies from the opium; and shall commence with that valuable extract, possessing such highly medicinal qualities, known by the name of *morphium*.

Sertuerner, impressed with the idea that morphium existed in the state of a salt, that is to say, in combination with an acid in the opium, at first advised the employ of ammonia, to separate this new base from the aqueous solution or extract of opium. But when he repeated his experiments, he endeavoured to convince me, that the alkaline precipitant did not enter into the alkalinity of the morphium; and he thought of obtaining his purpose with more certainty, by employing an insoluble and less energetic base. He accordingly substituted magnesia for ammonia, and this change has since been generally adopted; nevertheless, as morphium has now become an object of

great consumption; the manufacturers of it have been obliged to employ more economical, as well as more expeditious means of obtaining it; and thus, as ammonia possesses more advantages in both these respects, they have reverted to Sertuerner's first process, but with some slight modifications. Thus, following the advice of M. Hottot, they divide the necessary proportion of ammonia into two parts; and they commence by diluting the opium, from which they would extract the morphinum, with repeated washings in cold water; they then unite these washings, and reduce them to about a third part by evaporation, when they add the first quantity of ammonia, merely to neutralize the excess of acid in the opium; but this is not easily done, as the liquid being highly coloured, they cannot perceive its action upon litmus paper without difficulty. It then forms a flocculent precipitate, which scarcely contains any morphinum, and is nearly entirely formed of a coloured resinous substance, which was held in solution by the excess of acid. They pass it through a cloth, in order to separate this deposit; and again place the solution over the fire, and as soon as it boils, they complete the precipitation by the addition of a new quantity of ammonia, which they add in a slight excess. The elevation of temperature employed in this precipitation procures the advantage of driving off the too great excess of the ammonia; which they could not avoid adding, and which hindered the deposition of the morphinum in the liquid, by momentarily holding it in solution; it slowly deposits itself in cooling, and contracts a kind of granulated crystallization; which permits them to completely separate from it by a simple washing over, another more divided and flocculous matter, which accompanied it in its precipitation, and which, if suffered to remain in the mixture, would have rendered its purification much more difficult. It is nevertheless to be observed, that the deposit, so removed by washing over, is not to be rejected as useless; it still retains a little morphinum, which can be separated from it by a very dilute acid. When the

granular precipitate, which is nearly composed of morphinum, but mixed with a little colouring matter, is afterwards treated whilst hot with a little weak alcohol, it dissolves the greater part of the colouring matter, and also a little morphinum. They then filtre this first decoction and let the dregs cool, which still enclose a small quantity of crystals, which separate in cooling. They next pour off the fluid, and wash the residuum with cold alcohol, adding a little animal charcoal; they then pour over it alcohol of 40°, and boil it in a digester, under pressure, in order to increase the energy of the solvent. After boiling it for a few minutes, they let it cool in the digester, until they can open it without danger. They then filtre it in heated vessels, which are clothed, in order to prevent them from cooling too quickly. The morphinum crystallizes in abundance in the first liquids, and they separate the supernatant alcohol, in order to employ it anew, in new treatments of the residuum, and which they repeat until they have entirely exhausted it. If, however, instead of employing the same alcohol they were to use new, the morphinum which they would thereby obtain would be more and more colourless: and thus, after this first treatment, they are generally obliged to re-dissolve it, in order to obtain it in a sufficient state of whiteness and purity to fit it for medicinal use. In fact, the morphinum, by these reiterated solutions becomes separated, not only from the colouring matter which accompanied it, but also from the narcotine, which being more soluble in alcohol, remains in the mother-waters, with a little morphinum. In order to collect these, they unite the mother-waters, place them in a small alembic, and distil over three-fourths, in order to collect the alcohol. On suffering the remainder to cool, it deposits an abundance of coloured crystals, and of a greater size than those before obtained. They grind these, mix them with animal charcoal, or ivory-black, and purify them in a similar manner with the rough morphinum. They thus proceed until they have nearly obtained all the crystals;

the last which they obtain from the mother-waters are flatter and longer, and diffuse a strong odour of haw-thorn blossoms, when thrown upon burning coals, these are *narcotine*. It is very difficult to obtain these two salts perfectly free from mixture with each other, and yet this state of absolute purity is strictly necessary to fit the morphium for medical purposes. Nevertheless, when we would isolate them completely from each other, two means present themselves of doing it: we may either, as has been proposed, submit the mixture to the action of boiling ether, which dissolves the narcotine, without sensibly acting upon the morphium; or, which is still better, and according to the advice of M. Pelletier, treat the whole with a weak acid, and evaporate the solution to dryness, but with a duly regulated heat. The excess of acid, in dissipating, quits the narcotine, which, as we have before stated, is not susceptible of forming salts like the morphium. We then dilute the residuum with cold water, filtre it, in order to separate the narcotine; and upon afterwards decomposing the solution by ammonia we obtain the morphium.

In treating opium with cold water, a great part of the narcotine remains in the dregs, and in order to extract it, it is sufficient to treat it with an acidulated water, which increases the solubility of the principal crystals. We then filtre the solutions, and saturate them with ammonia, which precipitates the narcotine, together with many other substances; we then dry this precipitate, and treat it with boiling alcohol, which extracts the narcotine, and which we afterwards purify by repeated solutions and crystallizations.

The first physicians who experimented upon the action of narcotine on the animal economy, concluded from their experiments, that this substance was the essential cause of what they termed the *narcotism*, produced by the crude opium; but it appears from more recent experiments made by Dr. Bally, that a large dose of it may be taken without producing any mischievous effects, and that it is indeed as

one may say inert. It is highly desirable that we should precisely know what we have to trust to upon this essential point; but numerous experiments must be made and repeated before we can pronounce thereon in a definitive manner.

There has been successively proposed many modifications of Sertuerner's process for the extraction of morphinum; and it would be difficult, and occupy too much space, to report them all. We shall therefore confine ourselves to describe those which appear the most deserving of attention. In this number we find the proposal made by M. Dublanc, jun., who has been much and successfully occupied in studying the products from opium. His modification consists in adding a little acetic acid in the last aqueous washings, in order to facilitate the solution of the last portions of morphinum. But in fact he dissolves at the same time the narcotine; which, however, may be separated by the means we have above indicated. M. Dublanc advises us to continue the acid washings until the tincture of nutgalls will no longer occasion any precipitate in them; a certain sign that they no longer contain any morphinum.

The necessity for this addition of acid might appear to have but little foundation, if we admit, with M. Sertuerner, that the morphinum is naturally combined in the opium with an excess of acid, and therefore why should we add more to it? Nevertheless, it is also certain that acids singularly promote the solubility of the organic bases; as it is evident in the result of that excellent process, for which we are indebted to M. Henry, jun. for extracting quinine. And we may therefore conclude, with great probability, that these bases are, according to all appearance, combined in different vegetables, with certain resinous and colouring bodies, which cause their insolubility, and render it necessary to employ acids, sufficiently energetic to extract them in the aqueous vehicles.

There is also another process given by M. Guillermond, an apothecary at Lyons, in which he proposed to treat

opium immediately with alcohol, which completely dissolves the natural combination of the morphia, and then to add ammonia to the alcoholic tinctures, as is practised with the aqueous solutions. The morphia equally separates here in granular crystals, which must be carefully purified. M. Guillermond assures us, that this process, which will be found detailed in the *Journal de Pharmacie*, for 1828, is more expeditious, and affords a better product. We have repeated it, but did not find it to possess advantages sufficiently marked to induce us to abandon the method we had before adopted.

More recently, M. Blondeau, an apothecary at Paris, has proposed a process which furnishes results much more advantageous than the preceding ones, and consists in subjecting opium to an alcoholic fermentation, by diluting it with honey water, to which he afterwards adds some yeast, and then places the mixture in a stove conveniently heated. M. Blondeau thinks that he thus destroys the chief part of the substances which were united by mixture with the morphia, and hindered its extraction. When the fermentation is completed he filters the liquid, precipitates it by ammonia, and treats the deposit with a dilute muriatic acid; he then again filters it, and evaporates it, and thus causes the muriate of morphia to crystallize; this he collects upon a cloth, and submits it to pressure in order to free it from the mother-waters. He then moistens the muriate with a very small quantity of cold water, and submits it a second time to the press. He then adds these washing-waters to the first mother-waters, and submits the whole to a new evaporation, in order to obtain a second crop of crystals, and so on. On finally uniting all the washings of the muriate, he adds a little ivory-black, and dissolves it in the cold; he then filters and evaporates it. The muriate, thus purified, is white; and, in order to obtain the morphia, it is sufficient to dissolve it once more in water, and to add a little ammonia to it.

We see that this method of operating, has, for its princi-

pal aim, the avoiding the employment of alcohol ; but this saving is more than compensated for by the delay which all these manipulations necessarily occasion. We presume, that if the alcoholic fermentation really produces the good effects attributed to it, it would be better not to convert the rough morphia into a muriate, but to treat it directly with alcohol, as is done in the ordinary process ; and which would much shorten the operation. As for the rest, it is only experience which can determine the merit of these variations over those which are already sanctioned by use.

It has long been thought, that the poppy, which is cultivated in France, in order to extract oil from its seeds, and which is known under the names of *white oil*, or the *oil of pinks*, did not contain any sensible quantity of morphia ; or, at least, that the quantity was so small, that the product obtained would not compensate for the expence of procuring it.

We are indebted to M. Tilloy, a skilful apothecary of Dijon, for a process (see the *Journal de Pharmacie*, t. xii. for 1827), by means of which, we may extract with economy the morphia which is contained in the capsules of this variety of the poppy, and in a greater quantity than is generally supposed ; so that we may now, by treating the capsules of our indigenous poppy in a similar manner with the Oriental ones, obtain the advantage of extracting this organic alkali from them, when we can make no other use of them. The following is a summary account of this process :—

We commence with making an aqueous extract, we then treat this extract with alcohol, which will only dissolve a part of it ; we then decant, filtre, and distil it. We evaporate the residuum left in an alembic to the consistence of molasses, and then treat it anew with alcohol. In this way we separate, besides the gummy matter, as in our first process, plenty of nitrate of potash. We distil it anew, to collect the alcohol, and wash the residuum with water.

We next filtre it, in order to separate the resinous matter which was extracted by the alcohol. The liquid thus obtained, contains much free acetic acid; we then neutralize it with the carbonate of magnesia, and when there is no longer any effervescence produced we add caustic magnesia; and the morphia then precipitates. After leaving it at rest for twenty-four hours we filtre it, wash the precipitate, let it dry, and treat it in the usual manner with alcohol.

We see, from the ill-results obtained by all the others who preceded M. Tilloy in this kind of research, that in the capsules of the indigenous poppy, the morphia is relatively contained in a much less proportion than in opium; and that it is disguised by the gum, the nitrate of potash, the resin, and probably also by many other bodies. It is, however, possible to free it from these by successively treating it with water and by alcohol. It is also to be presumed that this mode of treatment when applied in other analogous cases, will equally produce great improvements in these kinds of researches.

Before we had acquired any positive facts as to the nature of opium, the practitioners endeavoured, by various processes, to separate the virulent part of it, to which they attributed the narcotic effects, produced by the crude opium when they administered it internally. And as the major part of them attributed these ill qualities to the oily or resinous matters contained in the opium, so they proposed diverse methods, having for their principal aim the freeing it from these. Such was that proposed by Josse, and which consisted in first washing the crude opium under a small stream of cold water, and then dissolving it in a large quantity of this vehicle; as, otherwise, they would have been obliged, in order to extract all the soluble parts, to have continued this washing for a very long time. They thus obtained their end, and precisely on account of the great mass of water employed, and which held the more

soluble parts diffused in this liquid ; though it is not always true to say, that, in order to bring more particles into solution, we can employ to advantage a larger proportion of the solvent. There are, indeed, certain bodies, and especially the organic compounds, which will not dissolve when diluted by a small quantity of the vehicle. And thus, in this actual case, the gummy, extractive, and other matters, would be entangled with the resin if we employed but little water ; we may then dilute them with advantage, and the influence of these more soluble bodies ceases to be exercised, and we can thus obtain a deposit. There are frequent examples of this kind in the pursuit of organic chemistry. We obtain then by this process of Josse's, an extract sufficiently cleared from resin, and we submit these aqueous washings to an evaporation carefully conducted ; and, above all, as recommended by some practitioners, we must sometimes suspend the evaporation, and separate, by filtering, the insoluble particles which it deposits. We must remind our readers that, it was by this process that M. Derosne separated the crystalline matter which was formerly termed *narcotine*.

We find mentioned in the pharmacopias *the gummy extract of opium* ; this is prepared nearly in this manner, only, in order to avoid this endless washing, they dissolve the crude opium at once in cold water.

It is well known that these aqueous extracts often possess the same inconveniences with respect to the narcotism produced by their use with the crude opium ; but it is not always the case. It is also certain, that the resinous part enters but in a very small proportion into these extracts, and that there are other preparations whose effects in this particular are much more striking, and in which it does not appear that the resin is excluded. Such is the justly celebrated receipt of the Abbé Rosseau, and which consists in submitting the crude opium to a spirituous fermentation, by mixing it with honey-water, and exposing the mixture

to the temperature of a stove. It is beyond all doubt, that some of the principles of the opium are destroyed by this process, but it is scarcely probable that they are the resinous ones, at least, if we may judge from those processes which are analogous to this; for, as alcohol is always produced by the fermentation, so it is to be presumed that part of the resin must be retained in the vinous liquor. He directs us, indeed, to submit it to distillation; but then he recommends us to unite the spirituous liquid with the residuum afterwards. Thus, it becomes self-evident, that a great part of the resin is retained; and yet if this preparation is faithfully made after the genuine receipt of the Abbé Rosseau, it is beyond contradiction the most sedative of all the preparations of opium.

Some authors have thought that the virulent and narcotic properties of opium resided in an essential oil, and they thought they had an authority for forming such an opinion from the stupifying odour which the crude opium exhales; but it is to be presumed that this essential oil would be found in the product of the distillation of Rosseau's laudanum, and which he directs to be preserved. And besides, there are some celebrated practitioners who pretend that this product of distillation possesses the same highly-quieting properties; and this we see prescribed under the name of *the white drops of Rosseau*! If all these assertions are well founded, we must necessarily conclude either that we know not all the elements of opium, or that some of their properties are not sufficiently appreciated. And we may also remark that those preparations of opium which are the least narcotic, have likewise the least smell. For the rest, it appears sufficiently well ascertained, that the morphia in which it was thought all the sedative qualities of opium resided, does not, nevertheless, possess that energy of action which is supposed to be due to the proportion of it contained in the extract; and thus we are generally obliged to employ more of it in proportion than

of opium, in order to obtain similar effects. We do not think it is possible to extract all the morphium that is contained in opium.

At the period when the active properties of opium were attributed to the narcotine, it was proposed to purify the gummy extract by steeping it during many days in ether, and frequently stirring or agitating it. This extract, thus deprived of its narcotine, appeared to many practitioners more sedative than the ordinary extract; and they even affirmed that they had obtained much more favourable results in those maladies where they could not support the smallest quantity of the ordinary aqueous extract of opium. It would therefore seem that the ether extracted other qualities besides the narcotine; this yet remains to be inquired into.

Amongst the other elements of opium, the meconic acid is one of the best known, after those we have above described; but as it offers much less interest we shall not dwell upon it. The discovery of it was made, as we have before said, by Sertuerner; but he did not take the pains to determine its principal characters. The process for the extraction of morphium by ammonia, afforded but little opportunity for isolating this acid, because it remained in combination with the mother-waters, and was also mixed with a great number of other substances; nevertheless, he advised us to precipitate it in the state of meconiate of barytes, by the addition of a solution of either the nitrate or the muriate of barytes; but, as there exists in the opium, according to M. Derosne, large proportions of the sulphates of potash and lime, it results, that the meconiate of barytes which precipitates, is also found to be mixed with much sulphate of barytes; and as the meconiate of barytes does not possess any considerable degree of insolubility, it follows that we can really obtain very little of it by this means. In order to separate the meconic acid from the meconiate of barytes, we must decompose it by the

méthod used in all analagous cases ; namely, by treating it with a sufficient portion of pure sulphuric acid.

When we employ magnesia for the extraction of the morphiwm, we can obtain the meconic acid more readily, because it is entangled in the precipitation with the morphiwm in the state of a sub-meconiate of magnesia with a great excess of base. When we have purified the magnesian precipitate by means of alcohol, from all the morphiwm it contained, we then take a dilute sulphuric acid, which we add, without ceasing, to saturation ; we then add a little of it in excess, and filtre it in order to separate the liquid part, which only contains the sulphate of magnesia ; and after having washed what remains of the deposit with a little water, we again add a new quantity of dilute sulphuric acid, and in a larger proportion, in order to completely dissolve the magnesian salt. We then filtre it, and evaporate it to a proper degree, and obtain, on its cooling, small crystals of the coarse meconic acid, which are granulated, and of a greyish colour. We separate these by means of a filtre, and mix them with a little ivory-black, we then dissolve them anew in boiling water, filtre, and obtain, on cooling, crystals in needles forming feathery groupés, and which are sometimes white, and at other times of a rose colour. But the most certain means of obtaining them perfectly pure is by sublimation ; only this method is attended with a considerable loss.

The meconic acid sublimes in the form of long white needles, of an acid and agreeable taste ; it is soluble both in water and in alcohol : but its properties are more characterized by producing a colour as red as blood in the solutions, even when largely diluted, of the muriate of iron, at a maximum.

Many other substances are also found in opium. M. Derosne found a resin ; a virulent oil, highly coloured ; the sulphates of lime, potash, and alumine ; the oxide of iron, &c.

M. Seguin has also shown the presence of the acetic acid in it, of a bitter principle, which cannot be precipitated by any re-agent, of an amylaceous substance, &c. And I have extracted from it, by treating it with ether, a glutinous elastic matter, which may be compared with caout-chouc; finally, it may be presumed, that this extract, so complicated in its composition, is yet far from being well known.

We know that opium is one of the most precious medicines which we possess; from its excellence as a sedative, it forms the basis of all the anti-spasmodic remedies, and we are obliged to have recourse to it in all the nervous affections.

The Orientals use it daily; but, according to our report, when they have taken too strong a dose in order to produce a kind of intoxication or delirium, which excites gaiety, and makes them despise dangers; after these first effects are produced, they fall into a heaviness, which is always followed by a feebleness and a debility, and from which they are only to be relieved either by taking a fresh dose of opium, or by drinking coffee.

The Chinese smoke it, mingled with tobacco; but we are assured, that before they use it, they deprive it of its virulent principle by a slight torrefaction: after which, they submit it to a new solution and a slow evaporation. They dissolve the torrifed opium in water, and afterwards evaporate it over a large fire, but they moderate the heat, when it forms a soft extract. They pretend that the opium purified by this means is less hurtful; and we have a proof of it from the testimony of Marsden, a very judicious observer, who affirms that he has seen the Malays never rest without smoking opium; but that, notwithstanding, they enjoyed excellent health. However, according to the reports of other travellers, equally worthy of credit, such is the abuse made of opium in Turkey and Persia, that those who indulge in it are in a continual state of de-

lirium, and in such a state of stupor, both of mind and body, that they resemble brutes!

R.

*Remarks by the EDITOR.*

The white poppy has been cultivated both in Scotland and in Berkshire with considerable success, for the purpose of extracting opium from it; and we know that ale, medicated by opium, forms the chief part of that popular English remedy, *Daffy's Elixir*.

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L.—*On the Manufacture of Red and Flame Coloured Glass.* By M. ENGELHARDT.\*

THE ancients employed the oxide of copper for colouring glass red; but the colour which this oxide gives to the glass is so intense, that glass of an ordinary thickness would be of a brownish-black colour, and but little diaphanous. It then becomes necessary, that in order to obtain a red colour, we must find out a process, by which this dark colour may be diffused or thinly spread over the glass without inconvenience. This may be effected by covering white glass with an exceedingly thin layer of the red glass; and by this contrivance we can unite the double advantage of having a fine colour, and a transparency also.

According to Kunckel, the oxide of gold is employed as the colouring principle in the colouring of red glass. And in fact the oxide of gold does produce a fine red, with which glass may be coloured in fusion, without prejudice to its transparency; and consequently it may be advantageously employed in the making of vessels and other similar objects. But its employ must always be greatly circumscribed on

\* From the *Kunst und Gewerbe-blatt*, 1824, and Ferussac's *Bulletin Technologique*.—Dr. Engelhardt received for his communication, a gold medal, and 300 écus; being the premium proposed by the Society for the Encouragement of Arts, &c. of Prussia.

account of the high price of this colour, and other difficulties. Thus, for instance, we cannot always obtain from the oxide of gold, the fine purple or flame-coloured glasses seen in the ancient windows of our churches; the glasses thus coloured have always a crimson or rose tint, and may be distinguished at the first glance of the eye. The property which the oxide possesses of colouring glass red, may be readily proved with a mixture of the glass of borax and the oxide of copper, and treating them with the reducing fire under the blow-pipe. For in order that the copper shall produce a red colour, it is essentially necessary that it be treated in the reducing flame. And it is for this reason, that with the bellows we cannot apply it in the state of enamel, as with the other colours employed in tinging glass; because the red glass becomes changed to a blueish-green colour, by the fusion, and the calcination of the copper in it.

Thus the ancients were obliged to use crude tartar, or lamp-black, or other de-oxidating bodies, when they would preserve their glass of a red colour. They also sometimes used the oxide of iron when they wished to obtain a red flame-colour partaking of yellow; but the agent which produced the best result in this respect was the oxide of tin. The effect of the oxide of tin was more certain and fixed than vegetable substances; but it also possessed the inconvenience of colouring the glass brown if the combustion was not perfect. During the whole time of working with the oxide of tin, they constantly kept the furnace at an uniform red heat; but this was not necessarily the case when they added the other de-oxidating substances. I have always found the oxide of tin in all the ancient glasses which I have analysed; and not only this oxide, but generally, also, a much larger quantity of the oxide of copper.

As the colour obtained from the oxide of copper is too intense to be worked alone, the coloured glass being in some parts opaque, and in others appearing of a brown

shade, and as it must be blown too thin for use, in order to obtain it of a transparent red colour, so they can only procure red and diaphanous glasses, by coating white glass with a very thin layer of the red glass. In this way they prepare a glass, which is termed *double-glass*; and which has likewise the advantage, of permitting us to remove the red coat, when we would either obtain white designs or drawings, or designs enamelled with other colours. We shall now state the process of the ancients, as we find used in all those glasses of the middle ages.

To manufacture this glass in layers, the workman employs two pots or crucibles, the one containing the red glass, the other the white; he commences by plunging his iron *cane*, or blowing-tube into the red glass, so as to bring out a lump of it, and then plunges it into the white glass. The cylinder blown out of this mixture thus affords a glass of a fine red colour. In order that the red layer should remain in perfect contact with the white glass, and should not detach itself in the cooling; it is necessary, that at the first forming, the union of the white glass with the red, must be made completely perfect; it is also better that the mass of red glass should be heated hotter in the crucible than the white; and care must also be taken, that the component parts of the red glass should not be formed of any oxigenating substances. In order to commence working in the glass-house fire, I first put in the small crucible to contain the red-glass, amongst the large pots. I then introduce into this first pot, in addition to the ordinary frit, or materials used to form glass (provided that they contain no maganese), two ounces of oxide of copper, and two ounces of oxide of tin, for every five pounds of the ordinary materials; but if it does not contain any such materials, I take for every two pounds of the sand contained in the frit, an ounce and a half of the oxide of copper, and an ounce of the oxide of tin. If I do not immediately add the oxide of copper, but introduce it afterwards, when the

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glass has become transparent, I then employ rather less of the oxide of copper.

To produce a scarlet layer, I take for every twenty-five pounds of the usual materials for making glass, half a pound of oxide of tin, and three quarters of an ounce of the oxide of tin, made into an exceedingly fine powder; and these I add at the commencement of the operation.

When the mass has become transparent, I then put in three quarters of an ounce of the oxide of copper, and mix the whole with great care. In general, I also take every possible pains to prevent the formation of any bubbles or lumps in the glass, which are but too apt to take place; I likewise take care that both the masses of the white, and of the red glass, be brought to the same degree of fusion whilst they are being worked.

The perfectly uniting of a fine glass, depends very much upon the skill of the workman, and he ought to make himself master of the details I have above given; and also, that the outer layer of glass should be thinner at the mouth of the tube, than at the opposite side of the cylinder; or else the glass would necessarily be deeper coloured at that end than the other, and then the centre would not present an even tint; and indeed, if one of the ends should become too thin, the colour would entirely disappear, and be lost in the white glass. I possess many glasses, however, in which the transition from the dark to the light tints, is employed in producing certain effects with great advantage.

For the rest the workman may soon acquire, by a little practice, the necessary dexterity to enable him to make uniform glasses, and of sufficiently large dimensions; and I hope to obtain this result in all our glass-houses, having made arrangements to that effect.

A mass or frit, containing lead, appears to preserve the red colour better than any other; nevertheless, my experience in this respect, is not sufficient to enable me to pronounce decisively thereon. When the red colour of the glass in

the furnace disappears at any time, owing to the oxidation of the copper, and the glass takes a bottle-green colour, by adding a de-oxidating body to it, such as charcoal in powder, crude tartar, lamp-black, or other analogous substances, we can again produce the red colour. The crude tartar or the charcoal are preferable for this purpose, as they can be more readily obtained in a state of purity than the lamp-black. After adding these de-oxidating matters, we should not use the upper layer of glass in the crucible, which is too deeply coloured, and too impure; but the lower parts soon become very fine, and of a clear tinge. Nevertheless, as that red is always the most beautiful in which there has been no occasion to employ these matters, so we should endeavour to avoid the necessity of adding them as much as possible, and strive to keep the mass of red glass continually transparent in the furnace.

*Remarks by the EDITOR.*

We believe that this process of forming red glass by *flashing*, as it is termed, white glass, has long been used in this country; and particularly by the late Mr. Honeybourne, of Brierly Hill, near Stourbridge, who was celebrated for his skill in making coloured glass. And we continually see the small red glass lamps, used in public illuminations, thus formed. The process may not, however, have been practised in modern times in Prussia; and this communication will, therefore, no doubt, prove highly useful there, as well as in other countries also.

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*On the Progress of Inventions connected with Navigable Canals. From the Boston Journal of Science, and the Franklin Journal.*

(Continued from page 255.)

In enumerating the improvements in the canal navigation, we shall commence with the lock. The period when

locks were invented does not now seem to be precisely known. On this subject, the writers in the *Edinburgh Encyclopædia* say, "We have been at some pains to trace the original discoverers of this important invention; and though our researches have not been attended with all the success we could wish, yet we have been enabled to acquire some new lights respecting the early history of an invention, which three centuries, perhaps four centuries, have not yet brought to its ultimate perfection. Belidor, in his *Architecture Hydraulique*, supposes the invention to belong to the Dutch, from some expressions used by Stevinus, an eminent engineer of that country, in his treatise *Sur la nouvelle Maniere de Fortification par Ecluses*, published in 1634; but that superficial enquirer does not seem to have comprehended the invention which Stevinus describes, who expressly says, that locks of the modern construction, a figure, and very correct explanation of one of which he gives, had been known in Holland from early times. His object was to describe a new kind of sea-lock, then lately invented, for the purpose of securing the harbours, and which might at the same time admit the passage of masted vessels. The difficulty was, to form gates which could be opened when the water on their two sides was at different levels. The inventions of several engineers there mentioned are described, and the preference given to the plan of turning gates, placed so as to fill up the frame of the common gates; and which, when let go, fall into the line of the stream.

"Stevinus first gives an account of the common mode of effecting the first object, as it had been in use for a long time, viz. the raising a common sluice door by a windlass, which, he says, does not allow the passage of masted vessels.

2.—"He describes the sluices used for draining low lands, consisting of two doors, abutting against the tide, and shutting of themselves, which, he says, are more use-

ful than raising the sluices, because they admit of being larger, and require no attention to watch the tide; but, he says, they are also defective in not admitting masted vessels, when they are placed under the dyke, and in not retaining water to scour the channel.

3.—“The third kind of sluices, serving to pass masted vessels, are made with two pair of pointed doors, like the second, but raised as high as the dykes themselves, and comprising between them a receptacle for ships; and with two small sluices, either made in the walls, or in the doors themselves. Then he describes briefly, the mode of passing a ship through the locks.

“Besides these, others have been made which open of themselves, with the ebb falling on the bed, and rise with the flood; also gates which are drawn aside into the land, but they are not convenient.

“Stevinus also informs us, that he and several other engineers had agreed to study this subject, and communicate their inventions to each other. The following was the result:—

“Adrian Janssen, a carpenter, of Rotterdam, invented the locket, for holding a turning-gate in its place. A turning gate had been made at Briel, which was retained in a groove at the bottom, out of which it was wound three inches high by a rack ere it could turn into the line of the stream.

“Stevinus’s mode was, to have rising vanes, the whole length of each abutting lock gate; Cornelius Dirricksen Muys, of Delft, to have second lock gates, holding up the first; and Adrian Dirricksen, of Delft, improved Janssen’s mode, by applying them in folding gates. He got a patent for it from the States, and built two at Maeslandsluis, and two at Helvoetsluis, of that kind, and which yet exist. Stevinus’s whole account of this mode of securing harbours is well worthy of attention.”

“Of the Italian authors, the first who enters into the

history of this discovery is Zendrini, in his treatise *Della Acque Corrente*, published in Venice, 1746, who says, that being interested in ascertaining the original inventors of locks, he had taken some pains to search the Venetian annals on the subject, and found that the first lock was invented at Stra, near Viterbo, by two brothers, named Dominico, clockmakers in Viterbo, who had a patent for its construction from the Senate of Venice, in the year 1481. The patent describes, that these engineers had engaged to construct a sluice (*concha*) in which boats might pass without danger; and which being so contrived, that the water passing out with facility, the vessels would neither require to be discharged, nor drawn over. This account has been acquiesced in by Lalande, and other writers; but Lecchi, in his book, *Dei Cannali Navigabili*, alleges that, previous to this period, in 1420, the lock had already been introduced in the navigation of Milan, by Fillippo Maria Visconti, as mentioned in his life, by Decembris, one of his courtiers. And 1188, Petentino, the architect of Mantua, had thought of it in his dykes on the Mincio, at Governolo, the first attempt at overcoming the fall of rivers in all Italy: so that Lecchi claims it for Lombardy. Nevertheless, there is every reason to believe, that these cases were nothing more than the wear, and single flood-gates, already used for the navigation of rivers; for Bertazzolo, in his discourse upon the sluice of Governolo, published at Mantuà, in 1606, proposes a lock with a chamber (*sostegno*) to be built at the sluice of Governolo, as a new thing. This lock has since been established on the left bank of the Mincio; and connected with an opening wear, it serves to hinder the turbid waters of the Po from filling up the lake of Mantua; while, at the same time, it preserves the navigation. Indeed, in many parts of Lombardy, wears with flood-gates are yet employed for river navigation, although locks exist of an early date, and some of them also of a singular magnitude and boldness.

To conclude, we may observe, that at all events, a very few years after the supposed invention in the Venetian State, the celebrated painter, architect, and engineer, Leonardi da Vinci, in 1497, applied locks to connect the Milanese canals, derived from the Adda and the Tesino.

“ We must next consider the claims of Holland, that other great cradle of the hydraulic art of Europe. We have formerly noticed that the embankment of the different districts of Holland had chiefly taken place between the years 1000 and 1400. In 1235 a placart was granted by William, Earl of Holland, to the city of Haaerlem, for the construction of the sluices of Sparendam. Those sluices must have necessarily been a lock; for it is expressly said to be constructed for the more convenient passage of ships, and a toll is appointed to be collected on the vessels which make use of it.

“ About the same time, viz. 1255, the jurisdiction of Deftland was established, and the ancient canal from thence to Leyden completed. On this canal, at the separation between Deftland and Rhineland, is the basin of Leidsendam, which, as we have already observed, becomes, to all intents and purposes, a complete lock, by means of the stop-gates belonging to the two jurisdictions at either end; and it has always been used as such.

“ At the same period the citizens of Utrecht had formed an aqueduct from the river Lech, at Vreeswyck; and in 1371, as we are informed by Hada, in the history of Utrecht, they deepened and enlarged this aqueduct, so as to make it navigable; and placed at the bank of the river Lech double flood-gates, or stop-gates of timber, by which the waters might be more easily kept out, or introduced. (Hedæ, *Hist. Epist. Ultraj.* Arnold ii. *Episc.*)

(*To be continued.*)

## LIST OF PATENTS FOR NEW INVENTIONS

*Which have passed the Great Seal since March 26, 1829.*

To William Church, of Bordesley Green, in the parish of Aston, in the county of Warwick, Esquire; for certain improvements in buttons, and in the machinery or apparatus for manufacturing the same. Dated March 26, 1829.—To be specified in six months.

To William Madeley, of Yardley, in the county of Worcester, farmer; for an apparatus or machine for catching, detecting, and detaining depredators and trespassers, or any animal; and which he denominates the Humane Snare. Dated March 28, 1829.—In two months.

To Josias Lambert, of Liverpool-street, in the city of London, Esquire; for an improvement in the process of making iron, applicable to the smelting of the ore, and in various subsequent stages of the process, up to the completion of the rods or bars; and also for the improvement of the quality of inferior iron. Dated March 30, 1829.—In four months.

To William Prior, of Albany Road, Camberwell, in the county of Surrey, gentleman; for certain improvements in the construction and combination of machinery for securing, supporting, and striking the top-masts and top-gallant-masts of ships, and other vessels. Dated April 11, 1829.—In six months.

To John Lihon, of Guernsey, but now residing at the Naval Club-House, Bond-street, in the county of Middlesex, a commander in our Royal Navy; for an improved method of constructing ships' pintles, for hanging the rudder. Dated April 14, 1829.—In six months.

GILL'S  
TECHNOLOGICAL & MICROSCOPIC  
REPOSITORY.

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LI.—*Specification of a Patent for the Construction of a Furnace for Generating Steam by Anthracite Coal, and for the Use of various Manufactures requiring Intense Heat. Granted to BENJAMIN B. HOWELL, Philadelphia, October 14, 1828 \*.*

WITH FIGURES.

THE improvements claimed, consist in the form and principle of the interior of the furnace, and in its being in a separate structure from that of the boiler, or other body to be heated; and by means of which the heat is generated without bringing the fuel into contact with the boiler or other body; and in the application of an artificial blast upon anthracite coal, and thus increasing, in a great degree, the intensity of the heat; and likewise giving it the necessary direction, through the communicating flues of the furnace, to act upon the bodies to be heated.

The drawings exhibit a front elevation, a ground plan, and a section; all made upon a scale of six feet to an inch.

The exterior shape and proportions may be varied at pleasure, provided the principles of generating and applying the heat be retained.

With a furnace of this construction, and a moderate blast, the flame and the heat may be carried to almost any required extent under the boiler of a steam-engine, or other

\* From the *Journal of the Franklin Institute*.

body, using anthracite coal as fuel. The blast may be obtained by attaching a small pair of tub or other bellows to the engine; and the machinery may be put in motion by using in the first place a small quantity of wood to kindle the fire. Power enough being thus obtained to start the bellows, no more wood will be required, until after the fire has been suffered to go down, and is to be again renewed.

The coal should always be kept, while in full operation, at about the height of *a*; or at least so much above the flue *b*, that it may become perfectly ignited before it sinks to that level. Attention to this is important in preserving a uniform temperature.

The additional power required to actuate the bellows, beyond that necessary for the ordinary work to be performed by the engine, will be very small; it is believed not more than that of a single horse, to an engine, of what is called forty-horse power, or about two and one half per cent.; but should it even exceed that estimate in a triple proportion, and experience justifies the conclusion that it will not, yet the economy of room on board of steam-boats, where space is so valuable, together with the other advantages hereafter mentioned, and the saving, in all other places, of expence in fuel, will much more than compensate this disadvantage.

But in addition to the economy effected by the introduction into general use for this object of a fuel existing in *inexhaustible quantities* in our own country\*, to the exclusion, in many situations at least, of one daily becoming more scarce and costly, a further and important saving will result in the construction of boilers adapted to this furnace, as nearly all the space now occupied by the wood, that is, the furnace part of the boiler, may be dispensed with; and in its place be substituted a narrow flue, for the passage of the heat under that part of the boiler containing the water. The part that may be thus dispensed with

\* And also in *South Wales*; and possibly in other parts of the United Kingdom. EDITOR.

forms an extensive part of the whole ; while the furnace in which the heat is now to be generated, being formed of a less expensive material, will be less costly. The great objection to the use of anthracite coal, in generating steam, arising from the necessity heretofore supposed to exist, of bringing the fuel into actual contact with, or nearly approaching to, the boiler along its entire surface, is by this plan entirely obviated ; as the coal is here never brought in contact with the iron, and which, of course, will be more durable than if constantly acted upon by the direct heat of the fuel.

The principles, both in the construction of the furnaces, and the generation and application of heat produced by means of anthracite coal, and an artificial blast, may be applied with equal advantage to the manufacture of glass, earthenware, pottery, the burning of bricks, and all other manufactures admitting of a like application of heat.

B. B. HOWELL.

*Notes and References to the Improved Furnaces for Using Anthracite Coal in Generating Steam ; and for various Manufactures requiring Intense Heat.*

In plate VI. figs. 1, 2, 3, represent an elevation, a vertical section, and a ground plan, all upon a scale of six feet to an inch ; and the same letters refer to the corresponding parts of each.

AA tuyeres for introducing blast.

BB line of flue for the passage of flame and heat under the boiler, or other vessel or body to be heated.

CC charging doors for coal.

DD cleaning-out doors, also occasionally used as draught-doors.

E upper surface of the coal.

FF grate-bars. Where it is inconvenient to use these, the bottom of the furnace may be closed, as the blast will sufficiently ignite the coal ; and the wood first

used may be ignited by throwing open the cleaning-out doors, at DD.

GG openings to promote the draught before applying the blast. These may be omitted in like manner with the grate-bars.

HH boilers.

The furnace should be lined with fire-bricks, and be cased with cast-iron plates, secured with strong bolts, screws, and keys; and between these common bricks may be used. If a thin packing or lining of sand be also interposed, it will be found useful, in preventing injury from expansion.

*Remarks by Dr. THOMAS P. JONES, Editor of the Journal of the Franklin Institute.*

But a very few years have elapsed, since the general impression in Philadelphia, and other places, where attempts had been made to use anthracite as fuel was, that we might as well attempt to burn bricks and stones! Yet it is now known to require less management than any other fuel; and those only experience difficulty who take too much trouble to succeed. After the coals are once placed in our grates, and ignited, their motto seems to be, "*laissez nous faire*," and observing this, every thing proceeds with the utmost facility. When it was admitted, not merely to answer well, but absolutely to be the best fire for our parlours, it was still thought by many, that it would never descend into the kitchen, as it was, from *its very nature*, inapplicable to culinary purposes; but here again it was destined to obtain a triumph. The fire-man of the steam-engine, and the iron-master, however, yet remained unconvinced; these averred that they had given it a fair and perfect trial, and that it would never do; there was still something in *its very nature*, which, in their occupations, forbade its use. You might as well have attempted to convince them that it was fit to be made into candles, as

that it might be employed for their purposes, if their furnaces were suitably constructed, and the fire properly managed. It appears likely, however, that it will soon assert its claims to superior excellence in these applications also, and triumph over the prejudices of the managers of furnaces, as it has over those of the householder, the cook, and the blacksmith.

That many abortive attempts would precede its successful use was to have been expected, as it differs in so many particulars from the fuel we had been in the habit of using; but it was evident that an intense heat was given out in its combustion, and if we could only transfer this to the water in our boilers, we must convert it into steam; and that in like manner it must reduce the ore, could the heat and the carbon be made to operate upon it. That there was nothing in the nature of things to forbid this we have ever believed; and are now fully persuaded, that in all cases, excepting where the action of a large volume of flame is necessary, this fuel may be advantageously employed.

When the application was made for the foregoing patent, some of its leading features appeared to us such as to merit particular attention; and the more so, in consequence of some circumstances mentioned by Mr. Howell, in a letter which accompanied his other papers, in reply to a communication addressed to him on the subject of his furnace. He says, "I am not surprised that my statement of the effects produced by the flame of anthracite has somewhat astonished you. That a fuel, which has heretofore been supposed incapable of producing *any flame*, should in truth be so powerful in this respect, is really wonderful! But it has, in fact, been hitherto but little understood; and too much has been taken for granted in relation to it. With regard to this particular property, the error has, I think, been caused by the practice of looking at the upper surface of the coal, the flame from which does not, until the coal is fully ignited, yield much heat, and is liable to

great variation of temperature, from the necessity of placing there new supplies of fuel, which for a long time give no heat whatever. In both my furnaces you will remark, that the heat is first generated *in close vessels*, and thence taken from that part where the heat is uniform and most intense. Under this arrangement the effect is really astonishing! The length of one of the furnaces, in which my experiments were made, was about six feet, and the height of the chimney ten; or the length of the flue, horizontally and perpendicularly, fifteen feet. The quantity of coal did not, I think, exceed a bushel, certainly not a bushel and a half; and yet the bricks at the top of the chimney were *red hot*; and the flame rose full six feet above the top, strong and vigorous.

“ I anticipate, that the idea of blowing a steam-boat fire with bellows will be ridiculed; but this, or something like it, will, I am persuaded, be adopted. Perhaps I go too far, in thinking it may be applied to glass-house furnaces, &c., but time will determine.”

We think Mr. Howell's remarks highly interesting, and hope soon to hear from him the results of his further important investigations and experiments. For the fact, of a flame of six feet in height, produced from anthracite, we were not prepared; nor are we now of opinion that the flame actually extended from the fire to the top of the chimney; but believe that the flue was filled with heated air, consisting of nitrogen, carbonic acid, and carbonic oxide; and that the latter inflamed, on its coming into contact with the oxygen of the atmosphere.

This remark has little to do with the practical utility of Mr. Howell's furnace; and is intended only to apply to the theory of the production of the flame which issued from the chimney; and which, we apprehend, was not twenty-one feet in length.

LII.—*Specification of a Patent, for an Improvement in the Manufacture of Malleable Iron; and of an Improved Bloomery Furnace. Issued to BENJAMIN B. HOWELL, Philadelphia, November 6, 1828* \*.

WITH FIGURES.

THE discovery consists of an improvement in the construction of the bloomery furnace; by means of which, and the use (in the manner hereinafter described) of *anthracite coal* exclusively for fuel, *iron ore is directly converted into malleable iron.*

The drawings in plate VI. exhibit an elevation, and vertical and horizontal sections. From these, and the notes and references, it will be seen, that this furnace combines within itself the advantages of both a close furnace and an open fire; in this respect differing essentially from any other now in use for similar objects. In the upper or close portion of the furnace, being all that above the hearth, with anthracite coal, excited by a proper blast, a degree of heat is obtained, much greater than can possibly be generated in the ordinary fire made with charcoal; while the lower portion opening into the hearth, and permitting the free action of blast upon the burthen, performs all the offices of the open fire or forge. The size of the furnace and the proportions may be varied, if the principle of the close and open fire be retained.

The furnace being first heated up, in the manner of a common cupola, the process is thus conducted:—The coal having settled sufficiently for that purpose, it is charged with the proper burthen of ore, which will vary according to the quality and kind. The charges are then continued, alternately, of coal and ore. The ore soon arrives at the tuyeres in a state of partial fusion, and is then, by the in-

\* From the same work as the last article.

tense heat of that part of the furnace, quickly separated from its earths; and then rapidly descending into and below the direct action of the blast, a large part of which is driven out at the open front, first passing over that portion of the ore which has reached the hearth; it is thereby brought, in the language of the workmen, "to nature;" or, in other words, into malleable iron.

As it sinks into the region of the blast, the small masses may be driven into one, and a loup shaped, by giving a proper direction to the pipes at the different tuyeres, and the loup can be removed with a proper instrument; another instrument, or strong iron bars being introduced at B, to hold up the burthen while this is doing. The loup may be drawn into a bloom under a forge-hammer, or be passed through rollers. In either operation it will of course be necessary to renew the heats, which may be done in a common chafery, or in a heating furnace. The process is continued at the pleasure of the workman; and as soon as a quantity sufficient for a loup accumulates, it is withdrawn as above described.

In the early stage of the operation it will be necessary to charge the furnace nearly or quite to the top; but as the heat increases, the height of the coal may be gradually diminished; and at a very high temperature, from two to three feet of coal will be found sufficient.

The cinder produced in this way, will in all respects resemble forge or bloomery cinder, and will bear working a second time; an appropriate flue facilitates the operation; and as it is first fused, and sinks, and is thus interposed between the iron at the bottom of the hearth and the coal, it contributes to prevent a mixture of the two.

Holes may or may not be left in the sides of the furnace, for the introduction of bars, to aid in detaching the iron from the bottom and sides; but this will not often be necessary, if the back of the furnace be thrown sufficiently forward, and a proper direction be given to the blast;

for which purpose, tuyeres are placed in different positions, on three sides of the furnace, and at different elevations. One or two pipes may be used at pleasure.

From the foregoing it must be obvious, that by the rapidity of the process, the saving thereby of time and labour, the substitution of a cheaper, more powerful, and abundant fuel for that now in use, and which is made so applicable to this object, by the peculiar construction of this furnace, that a great and important improvement has been effected, in the conversion of iron ore into malleable iron.

B. B. HOWELL.

*Notes and References for the Improved Bloomery Furnace.*

The drawings, figs. 4, 5, and 6, in plate VI., represent an elevation, and vertical and horizontal sections, all drawn upon a scale of three feet to an inch; and the same letters refer to the corresponding parts of each.

A trundle head, where the furnace is charged, to be provided with a cover, which is placed on in the intervals of charging, when the coal is low.

B projecting, open, hollow hearth, for the reception of cinder and iron, with a cinder-hole at c, to be opened when it is wished to draw off the cinder.

DD tuyeres, for the introduction of the blast, placed in different positions on three sides of the furnace, and at different elevations, to vary the direction of the blast at different stages of the process.

The back and front inner-walls may both, or either, be thrown or inclined somewhat more inwards than is represented in the drawing, and as indicated by the dotted lines in the vertical section, and with advantage when the ore is not very pure, and makes much cinder.

The furnace should have over it a brick canopy, or a chimney, to aid in giving a direction to the gas given out by the coal, which is distressing to the workmen, if largely diffused immediately around it.

The furnace should be lined with fire-bricks, and be cased with cast-iron plates, secured by strong bolts, keys, and screws; and between the casing and lining common bricks, with a thin lining of sand; the latter to prevent injury from expansion.

*Notes on the foregoing, by Dr. THOMAS P. JONES, Editor of the Journal of the Franklin Institute.*

In a letter from the Patentee, which was received with his application, he observed, "I some time since mentioned to you, that I had then completed some further experiments with anthracite coals, the result of which I should soon communicate to you, and which I thought would both interest and surprise you. The papers which I enclose will explain what these experiments were. They relate to an improvement in the bloomery furnace, and in the conversion of iron ore into malleable iron, with anthracite coal exclusively. In this, in six different experiments, I completely succeeded; making, in a comparatively short time, perfect bar iron; and indeed nails, without suffering it ever to cool. Practical forgemmen, who performed the manual labour, were astonished beyond measure at the result. It was, indeed, complete in every respect, the iron being as good as that made at the neighbouring forges in the old way.

"Refining of pig-iron has been attempted in Pennsylvania, but I believe abandoned, from the difficulty of preventing a mixture of coal with the iron in its soft state; this, in my method, is obviated almost entirely. The process is rapid, and even here, where the coals are high, is economical. How much more must it be so, where coal and ore can be had for digging?"

The Editor has in his possession a part of the bar, and a nail, forged directly, and without cooling, from the first bloom made in this way. He will seek for further information upon the progress of this improvement.

LIII.—*On the Microscope.* By the EDITOR.

(Continued from page 263.)

## WITH FIGURES.

*On a singular production formed upon the body of a dead larva of a gnat, one of those given to the Editor by Mr. C. GOULD.*—One of these larva having lately died, the Editor removed it from the bottom of the vessel containing the remaining living ones, and placed it, surrounded with water, upon a slip of glass, under his microscope, for examination. He was much surprised, however, at finding it covered all over, and surrounded with a number of slender transparent tubes, with hemispherical ends, each tube being also filled at its external end with several rows of minute spherical bodies, and presenting the appearance of that shown in fig. 7 of plate VI. But whilst observing them, he was still more surprised at finding, as the water gradually dried up, that these tubes opened in succession, and discharged their contents into the surrounding water, and where these small spherical bodies instantly commenced swimming about in a lively manner in every direction, and continued to do so until the water was entirely evaporated. Their appearance resembled that shown in fig. 8; and even in the dried transparent object, which the Editor has defended with a slice of talc, they are still to be seen.

The growth of this singular production must have been most rapid; as, but the day before, the larva was seen swimming about as lively as its companions. However, upon since examining other dead ones, the Editor finds the rudiments of these tubes adhering to their bodies; so that they seem to prey upon them in the manner of other parasites; and instantly upon their death, to commence their work of decomposition. The Editor is not aware whether others have also witnessed this very extraordinary circum-

stance, but takes the earliest opportunity of stating the fact.

*On the clustering polype.*—The Editor is indebted to Mr. Gray, of the British Museum, for the information, that in a pond, at the back of the Red House Tavern, Battersea Fields, and which pond occasionally communicates with the River Thames, the flat spiral snail is found, with these polypes adhering to its shell. He accordingly proceeded there, and collecting several of these snails, which he found affixed to the floating leaves of the water flags, &c.; he brought them home in a small vessel, surrounded with other aquatic plants, and the water which drained from them, and immediately placed them in vessels filled with the New River water. He had the pleasure of finding that the shell of one of these snails was abundantly peopled with several colonies of these clustering polypes, and which each appeared like a small spot of white mucous; but upon placing the snail in a small glass cistern, filled with water, and examining it under his microscope, the clusters appeared like so many tufts of pinks, but with much more numerous heads, and indeed consisted of several thousand polypes. By attending to the above particulars, our readers will now find no difficulty in possessing themselves of this beautiful microscopic object.

*On the exuvia of the larva of the ephemeron.*—The Editor finding upon the leaves and stems of the aquatic plants abovementioned, many bags of the eggs of the water snails, he removed several of them, and put them into the vessel of water containing this larva; and which, as it had been but sparingly provided with food before then, instantly commenced feeding upon the eggs; and possibly, in consequence of the additional strength it thereby acquired, it has since cast an exuvia, which the Editor immediately secured between two glass slips, and it now forms one of the most exquisite of his microscopic objects.

*On the exuvia of the larva of a gnat.*—This exuvia was

procured by the Editor, in consequence of an accident, the reverse of that abovementioned ; as in consequence of the remaining larvæ of those presented to the Editor by Mr. C. Gould not being so well fed as they would have been in a state of nature, they are become so much weakened, as not to be able to undergo their changes from the larva into the pupa state, and several of them have died in consequence. One of these the Editor has secured as a transparent microscopic object for his microscope, placed between glass slips ; it consists of the pupa, with the exuvia of the larva still adhering to it ; and which being entirely free from the glutinous matter, which always escapes from the body of the larva, when pressed between two slips of glass, exhibits the teeth, jaws, and other appendages of its mouth, in a most clear and satisfactory manner ; so much so, that the Editor has caused the magnified representation thereof, given in fig. 9, to be copied therefrom ; and in which *a, a*, are two stout limbs, articulated to the front of the head, each having four curved and stiff branches appended to it ; *b*, one or two tufts of stiff hairs, thickened at their root ends ; *c, c*, two slender and pointed limbs, articulated to the under part of the head ; *d*, a thick flexible part, also affixed on the under part of the head, and having tufts of hairs at its lower end ; this is moveable occasionally at the will of the larva, and serves to assist in bringing its prey within reach of its jaws ; *e*, two pairs of formidable jaws, armed with sharp teeth ; *f*, one of two other tufts of hairs, affixed to the head above the jaws ; *g*, one of two teeth, mounted upon short limbs, affixed to the head beneath the jaws ; *h*, fixed teeth ; *i*, one of the compound eyes.

*Mr. Philip Carpenter's achromatic solar microscope.*—

This very superior instrument is now removed to the larger and more lofty room, in which his microcosm, or collection of lucernal microscopes was placed last year ; and he has thereby not only been enabled to gratify a much more numerous audience, but which is of more consequence, he has now a

white circular area, of nine feet in diameter, to receive the images of the objects upon; and which, nevertheless, he fills most perfectly; some of the larger objects being magnified to the enormous size of upwards of eight feet in length! We were indeed highly gratified at seeing the field occupied with a number of living larvæ of the gnat, similar to the abovementioned one, and each swimming about at full liberty.

*Mr. P. Carpenter's Microcosm, or collection of lucernal microscopes.*—This collection of microscopes is now arranged in a kind of temple, placed in the middle of the room, and they are all illuminated by the light of one powerful Argand lamp, so as now to be independent of all natural light; and thus, in all seasons, even in cloudy weather, the objects are as brilliantly displayed as they could only be last year when the sun shone.

*On the beautiful appearance displayed upon the coat of the seeds of the flesh-coloured lupine.*—On a recent visit to Mr. Thomas Carpenter, the Editor was highly gratified by him, with a sight of this curious object, under the power of his opaque microscope. It presented the appearance at first of a number of crystals, variegated with fine prismatic colours; but upon the Editor taking a more accurate view of it, he found that this appearance was produced by a number of exceedingly thin and ragged films, which were supported upon the summits of numerous conical bodies affixed to the coat of the seed. Fig. 18 represents a few of these frustrums of cones, with portions of film adhering to their summits. This film, most likely, at first was entire, and completely surrounded the seed; but in drying had shrunk so considerably, as that only portions of it remained. The conical bodies are striated in the manner shown in the figure.

(To be continued.)

LIV. — *On the Cock-Chafer, the Rose-Chafer, some Spiders, and the Aphides.* By Mr. THOMAS CARPENTER.

WITH FIGURES.

DEAR SIR,

London, May 2, 1829:

IN the second volume of your *Technological Repository*, page 349, you have recorded a few facts, as stated by me, on the great tenacity of life possessed by some insects. I now beg leave to mention another circumstance of that kind, which I was an eye witness to last summer.—In walking across a field; leading from Tottenham to Southgate, I observed the foot-path covered, for many yards in length, with the wing-cases of numerous cock-chafers, the bodies of which I imagined had been eaten by birds. On my examining this scene of devastation, I observed that several of the heads of these insects were still in a living state, with their antennæ in motion. Some of these heads I took home with me; and on looking at them the next day, I found that life was not even then extinct, but that motion still continued in their jaws, palpi, and antennæ. This circumstance induced me to repeat my walk to the same place, in order to make some further observations. On my arrival at the spot, I found that the work of destruction had been continued by the birds; and that several of the cock-chafers were actually crawling about without heads, only part of their bodies being attached to their legs! It would therefore seem; that after these poor creatures were left in that state by the birds, the work of destruction was taken up by other creatures, for they were attacked by numerous bodies of small black ants; which had crawled up the sides of the chafers, and had taken possession of the interior of their bodies, and were devouring them alive. Many of the heads, I observed, were also being carried away by the ants to their nests. If the sense of feeling in these insects was as acute as in the

higher order of animals, the pain they endured must have been dreadful. I had indeed before frequently seen an individual of one species of insect, making a meal from another species ; but never before did I witness such a host of canibals engaged in their work of eating up, alive, insects that were actually crawling away with their devourers within their bodies !

In many instances, these expert anatomists, the ants, had so completely cleared away all the moist and pulpy parts of the inside, that scarcely any thing remained but the muscles and blood-vessels ; and although I could not examine these unfortunate insects in that state without an unpleasant sensation, yet the sight was really astonishing ; such extensive ligatures of the muscles, and such numerous large and small vessels, branching off in every direction, formed one of the finest displays of anatomy that I had ever witnessed ; and thus made manifest the wonderful power displayed by an Almighty Creator in the construction of these despised creatures ; and which are indeed but too often made the subject of wanton sport by many persons, who amuse their children by passing a pin through the bottom of their abdomen, in order to excite pain and long suffering in the insect, and thus making them spin, as they ignorantly term it. Many of these cruel sports might undoubtedly be effectually checked, if the teachers of schools were occasionally to exhibit to their pupils, under the microscope, the various parts of an insect, with which they are familiar ; and by interesting lectures of instruction, to point out the uses to which those parts are applied by the insect, for its preservation and comfort ; and that when they are deprived of them, or they are even injured, a degree of suffering takes place in the creature, which the children at present seem to be wholly uninformed of. I certainly think, that if the abovementioned useful lessons were inculcated, they would afford a check to those cruel propensities in many children, which they at present indulge in, for want of being better instructed.

As the cock-chaffer (*the Melolontha vulgaris*) is an insect so universally known in England, some account of its history and habits may be interesting; and particularly as its voracity is such, both in the larva and perfect state, that it is more destructive to vegetation than almost any other of the insect tribes. The eggs are deposited in the ground by the winged insect; from each of these proceeds, after a short time, a whitish worm with six legs, a red head, powerful jaws, and strong claws; and which increases in size until it becomes about an inch and a half long. In this state it is destined to live in the earth for four years, and then undergo various changes of its skin, until it assumes its proper form. It subsists, during its subterraneous abode, on the roots of trees and plants, often committing ravages of the most deplorable nature. These creatures, sometimes in immense numbers, work between the turf and the soil in the richest meadows, devouring the roots of the grass to that degree, that the turf rises, and might be rolled with almost as much ease as if it had been cut with a turling-spade; and underneath the soil is converted into a soft mould, for about an inch in depth, like the bed of a garden. In this mould the grubs lie, in a curved position, on their backs, the head and tail uppermost, and the rest of the body buried in the mould. Mr. Arderon, of Norwich, mentions his having seen a whole field of fine flourishing grass, in the summer time, become in a few weeks withered, dry, and as brittle as hay, owing to these grubs devouring the roots, and gnawing away all those fibres that fastened it to the ground, and through which alone the grass could receive nourishment. The larvæ, towards the end of the fourth year, dig deep into the earth, sometimes five or six feet, and then spin a smooth case, in which they change into the pupa or crysalis; and about the month of May the perfect insects are produced. They fly in the evening about sunset, and particularly about places where there are trees; they eat the leaves of all sorts of fruit trees, and of various other kinds.

In its winged state, this insect exhibits no less voracity in devouring the leaves of trees, than it before did in its grub state in the earth ; for such is the avidity with which it devours its food, and so immense are sometimes their numbers, as, in some particular districts, to have rendered it an oppressive scourge, that has produced much calamity among the people. I have set open the mouth of one of these insects in its perfect state, in order that you may examine its powerful jaws, and the teeth with which it makes bare the trees.

In the year 1688, the cock-chafers appeared on the hedges and trees of the south-west coast of the county of Galway, in clusters of thousands, clinging to each others' backs, in the manner of bees when they swarm. During the day they continued quiet, but towards sunset the whole were in action ; and the humming noise of their wings sounded like distant drums. Their numbers were so great, that for the space of three or four square miles they entirely darkened the air. Persons travelling on the roads, or who were abroad in the fields, found it difficult to make their way home, as the insects were continually beating against their faces, and caused great pain. In a very short time the leaves of all the trees, for some miles round, were destroyed ; leaving the whole country, though it was near Midsummer, as naked and desolate as it would have been in the middle of winter. The noise that these enormous swarms made, in seizing and devouring the leaves, was so loud, as to have been compared to the distant sawing of timber. Swine and poultry destroyed them in vast numbers : they waited under the trees for the clusters dropping, and devoured such swarms, as to become fat from them alone. Even the native Irish, from these insects having eaten up the whole produce of the ground, adopted a mode of dressing them, and used them as food. Towards the end of summer they disappeared so suddenly, that in a few days there was not a single one left. A year or two afterwards, it was supposed, that a supernumerary

swarm from the same place whence the first stock came, in endeavouring to make their way, were, by contrary winds so checked, as to fall from weakness into the sea ; as all along the coast of the county of Galway, for some miles together, there were found dead on the shore such infinite multitudes of them, and in such vast heaps, that by a moderate estimate, it was computed there could not be less than forty or fifty horse loads in all ! In 1785, many provinces of France were so ravaged by them, that a premium was offered by the government for the best mode of destroying them.

About sixty years ago, a farm near Norwich was so infested by them, that the farmer and his servants affirmed, that they had gathered eighty bushels of them ; and the grubs had done so much injury, that the court of that city, in compassion to the poor fellow's misfortune, allowed him twenty-five pounds. Mouffet informs us, that in the year 1574, there were such multitudes of these insects in the western parts of England, that those which fell in the river Severn, completely clogged the water-wheels of the mills ! The rooks devour immense numbers of the larvæ of this destructive insect, by which they render an essential service to mankind ; and great care therefore ought to be taken to cherish and protect them ; but instead of so doing, it has been customary, in many parts of England, to break up the colonies or rookeries of these birds, from a mistaken notion, that they destroyed the roots of the grass, by pecking at it ; whereas, in fact, they were only opening the ground to get at the grubs. These birds may be seen in great numbers following the husbandmen in the fields, in order to pick up the larvæ as they are turned up by the plough. The sole employment of rooks, for nearly three months in the spring of the year, is to search for insects of this sort for food ; and the havoc that a numerous flock makes among them must be very great.

A cautious observer, having found a nest of young jays, remarked, that each of these birds, while yet very young,

consumed at least fifteen of these full sized grubs in a day; and averaging their sizes, it may be said that they each consumed twenty; this, for the five birds, makes a hundred; and if we suppose the two parents to devour between them the same number, it appears that this family consumed about two hundred every day. This, in about three months, amounts to about twenty thousand. But as the grub continues in the same state for about four years, this single pair of birds, with their family alone, without reckoning their descendants, after the first year, would destroy as many as eighty thousand grubs. Now, supposing that forty thousand of these may be females, and each female lays, as is the case, about two hundred eggs, it will appear that no less than *eight millions* of grubs have been destroyed, or at least have been prevented from being hatched by this single family of jays! Some farmers take the pains to dig deep, wherever the rooks point them out, by their attempts to reach them. A person near Blois, in France, employed in the year 1785, a number of children and poor persons, to destroy the cock-chafers, at the rate of two liards a hundred. In a few days fourteen thousand were brought to him. Thus, for the moderate sum of about seven shillings and eight pence sterling, he destroyed, according to his calculation, near a million and a half of the grubs; which, had they been allowed to be hatched, might, in the course of four years, have done damage to the amount of many thousand pounds.

The cock-chaffer, looking at it superficially, does not appear to possess any particular marks of beauty; but if certain parts of it are placed under the microscope, many beauties will be discovered; and in order to furnish you with the means of examining these, I send you a perfect specimen, with its antennæ finely displayed; as also two of the heads I had found in the foot-path. The antennæ, or horns of these, are very fine objects, far exceeding the workmanship displayed in the horns of any quadrupeds. And if viewed under the lucernal or lantern microscopes, become

highly interesting. But if viewed in the solar microscope, using a moderate power, they then exhibit a most magnificent spectacle. I also send a piece of one of the wing-cases, which to the eye appears covered with a fine mealy powder; this apparent powder you will find to be most delicate spines, some of which I have scraped off, and placed between two slips of glass; at one end of each of these spines there is a minute quill, by which each spine was attached to the wing-case of the insect. I likewise send you parts of the abdomen, in the state in which it was left by the ants; and although the muscles and various vessels are in a dried and shrivelled state, yet you will discover much curious structure therein. Some small pieces of skin, taken from the intestines, I have also placed between slips of glass for your examination. You will find numerous and minute vessels in every part of these pieces; and between two other slips of glass, I have enclosed the dissected eyes of one of these insects, which you will perceive to be compound ones; and in each of the lenses in the cornea, the image of any object may be distinctly seen.

I send you also one of our most splendid British insects, the rose-chafer, the *cetonia aurata*, which, with several others of the same species, were produced from the larvæ under my own inspection, in the following manner:—I had occasion, early in the spring, to dig down to the root of a white rose tree in my garden; close to the root I found several grubs, about the size of my little finger; these I placed with some mould in a large garden pot, and among the mould I put several pieces of the decayed root of the rose-tree. I then placed the garden pot in a hole made in the earth, and covered the top over with an earthen saucer, perforated with holes. They remained in this state the whole year; and in the following spring I emptied the garden pot, in order to examine them, and found they were busy in constructing their cases, previous to their change into the pupa state; and which was done by their

cementing small particles of earth and sand-stone together, making the inside smooth, and leaving all the rough surfaces on the outside. Thus they completely enclosed themselves within an oval, oblong enclosure, about the size of a small walnut-shell. In this state they remained the whole of another year, and in the spring the perfect insects came forth. With the insect I also send you some of the cases in a whole state, containing beetles, which were too weak to extricate themselves; also a small portion of one of the cases, from which you will perceive in what a curious manner the cases, in which they were immured, were constructed. It appears that these insects remain under ground in their larva state four years, in a similar manner to the cock-chafers. When I have the pleasure of a visit from you, I will show you the numerous rose-chafers which were produced from the larvæ I had placed within the garden pot, as above described; you will then perceive the exquisite beauty of the insects. The upper part of the female is of a shining green colour, varying according to the light in which it is held, and is marked transversely on the wing-cases, with a few short white or yellowish lines. The male is of a burnished copper colour, with a greenish cast. In short, they must be seen, as it is impossible to describe the beauty with which every part of them is adorned.

I also send you three spiders, which appear to be very scarce, and are a variety of the species described in your third volume, page 6, under the article, "On the long legged or Shepherd Spider." These three insects I found under the bark of the willow, in company with the curious larvæ of the dermestes, mentioned by me in your present volume, pages 265, and 276; if you examine these spiders, you will find the characters differ from the former ones, and particularly where the eyes are posited, each spider is furnished with two rows of very strong spines. The eyes are two in number, very large, and are placed on each side of the mount on the back of the insect. With these you

will also receive the head of a large foreign spider. The fangs of this insect are very powerful, and are furnished with strong teeth. They are jointed, and fold together like a clasp-knife. I wish to direct your attention to the points of these fangs, near which you will perceive a small indentation or aperture, through which, it was supposed by Leeuwenhook, that the spider discharged a poisonous fluid into the wound it had inflicted on its prey; although Dr. Mead, indeed, in his *Essay on Poisons*, denied the existence of any such opening; observing, that he had examined many spiders, but could never discover any such aperture; this will prove Dr. Mead to have been in error. But this aperture is not merely confined to the larger species of foreign spiders, for I have frequently observed it in several of our British spiders, when examined under the microscope in a proper light.

In your third volume, page 19, in my communication "On the Blight in Hop Grounds," I mention, that Huber states, that during part of the winter, the honey-dew which exudes from the aphides is the principal food of ants. This fact is fully corroborated by a circumstance which Mr. Mylne, of Clapton, related lately to my friend, Mr. Samouelle, of the British Museum, and myself. A friend and neighbour of his, had occasion to dig deep at the root of an apple-tree, and discovered a colony of the aphides, and with them numerous ants. On his disturbing this settlement, it was curious to witness the anxiety manifested by the ants towards the aphides; they were running about in every direction; several of the ants had an aphid in their jaws, and many of them a couple, endeavouring to convey them to a place of safety.

I send you herewith a phial, containing numerous aphids, which were found by Mr. Hatchet, of Kingsland, at the root of a tulip. Mr. Hatchet had often been disappointed in bringing some of his tulips to perfection, and was at a loss to ascertain the cause thereof. He now considers this circumstance, of finding the aphides at their

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roots, as a sufficient reason for their not coming forth into fine bloom. He imagines that the aphides extract with their proboscis the juices which should nourish the plants, in order to bring them to perfection.

I now conclude, submitting these various objects to your examination, and requesting the favour of your remarks thereon.

I am, dear sir,

Your's very truly,

To T. GILL, Esq.

THOS. CARPENTER.

*Remarks by the EDITOR.*

In plate VI., fig. 10 represents part of the head of a cock-chaffer, greatly magnified, with one of its beautiful antennæ displayed. This consists of a branched part, articulated to the side of the head, and seven oval plates, connected together at one end, and to the branch. Fig. 11 represents one of these united to part of the branch; fig. 12, one of the middle ones, with an open oval hole at one end of it; and fig. 13, an external plate; no aperture is visible on this side of the latter, but it is articulated with the adjoining plate by an oval cavity at one end of it.

Fig. 14 exhibits some of the spines, in their places, upon part of the wing-case of a cock-chaffer. These spines are white, and thus form a pleasing contrast with the dark brown ground of the wing-case.

Fig. 15 is a greatly magnified front view of the head of a cock-chaffer, exhibiting its two pair of jaws and open mouth.

Fig. 17 represents the body of the long-legged, or shepherd spider, mentioned by Mr. T. Carpenter, considerably magnified, with most of its legs removed; the parts of those which remain, are, however, armed with spines, in the manner shown. The two rows of circular spines, which surround its eyes, are also exhibited.

LV.—*On the Natural History of the Honey Bee, and on the Importance of its Products* \*.

THE bee seems to be a native of every part of the globe, and the same characteristic traits distinguish the whole race; we allude simply to the honey bee, the *apis mellifica*. Even in New South Wales, we find that, excepting in some variation of size and colour, the honey bee is the same with that of Europe and America. The history of one bee, and of one community of bees, is, with the slight variation which is always produced by climate, the history of the whole race; nor should we venture to add our stock of observation to the great mass of what is already known upon the subject, and accessible to every class of persons, did we not wish to excite the attention more particularly of those who inhabit the mountainous districts of our country, to this practicable and profitable branch of horticulture.

From the commencement of history, to our own day, bees have been an object of attention, honey has been used, and wax has been an article of commerce. In fact, the amount of the former consumed for food, medicine, and a pleasant beverage, and of the latter for various purposes in the arts, would astonish those who have never turned their attention to the subject. In the savage and civilized state, wherever there has been sun enough to mature a flower, every individual of the community is as familiar with the luxury of honey, and the merits and uses of bees' wax, as with the daily food that is consumed.

Man has never been slow to appropriate to himself the physical powers of the inferior animals; but of all those which have been subdued to his use, the bee alone has preserved its independence. We ought not, in fact, to use the term *subdued*, as it does not apply to the situation or position which the bee holds among us in its domestic

\* From *The North American Review*, for October last.

state. Neither its nature nor its habits are, in anywise, altered or modified. It preserves its singular economy unchanged, whether it inhabit a hollow tree in the midst of an unfrequented forest, or an hive in the centre of an apiary.

And here we would remark, that a hive ought not properly to be considered as the house or habitation of the bee; for even in the forests, where there may be supposed to be abundance of hollow trees suited to their purposes, bees have built their cells on the under side of a stout branch; and they have neglected the convenient form of a well constructed hive, to attach themselves to the eaves of a house, or to the inner sides of a chimney. The nature of this part of their instinct goes no further than to secure a *firm roof* to which they can attach the cells, and a position that shall protect the cells from the sun and rain.

This faculty or instinct is sometimes at fault, for we often hear of their adopting the strangest and most unsuitable tenements for the construction of cells. A husar's cap, so suspended from a moderate sized branch of a tree, as to be agitated with slight winds, was found filled with bees and comb. An old coat, that had been thrown over the decayed trunk of a tree and forgotten, was filled with comb and bees. Any thing, in short, either near the habitations of man, or in the forests, will serve the bees as a shelter for their combs.

If this instinct were as absolute as some persons would make us believe, the bees, when swarming, would undoubtedly choose a domicile as nearly similar to the one they had left as possible; but this is rarely the case. In their pursuit of food, with which the woods as frequently supply them as the gardens, their quick eye guides them to the places suitable for the establishment of a swarm. They do not, by a distinct succession of thoughts, arrive at the conclusion, that the hollow tree will suit them as a dwelling; but they find it unoccupied, they pass it daily, and when the whole swarm is collected on the branch of a

tree, these foraging scouts that have espied the hollow tree, run over the mass of bees as they hang, give the signal of departure, lead the way to the woods, and the queen and the whole swarm follow to the selected tree.

But although the bees are rarely unprovided with a retreat for a new swarm, yet they readily accept of a more obvious one when offered. Aware of this willingness on the part of the bees, man takes the opportunity when they are collecting their numbers, of introducing them into a hive, and of bringing them under his own immediate *surveillance*, that he may more easily partake of the fruits of their labours. Yet, although colony after colony have dwelt in uninterrupted succession in a particular apiary, their instinct is not improved, nor their reflective powers enlarged. They are the same in all their instincts and formations, as they were when the first observations on their habits with which we are acquainted were made.

We have for seven years had a little colony under our immediate inspection, and we began our personal observation with the knowledge of all that ancient and modern theorists have advanced in relation to the habits, customs, and manners of this wonderful insect. We came to their superintendence with a mind tinctured with all that was marvellous and fanciful, and with an ardour that seven years have not subdued; although theory after theory have now melted away, and most of the wonders and enigmas have been solved and reduced to the clearest and most simple particulars. Our wonder and admiration however, although deprived of the charms of the fanciful legends, in which the history of the bee was embodied, are still undiminished, nay, increased, for an elevation of thought and feeling has been produced by the study.

Notwithstanding the astonishing sagacity to be traced in the economy of bees, and the diversity of habits which might be expected, nature in reality is less variable in this instance than in most others; for although climate and a contracted habitation may reduce their size, and scanti-

ness of food their numbers; yet, as long as there are flowers, the bee will abstract the honey, and as long as there are forests, the bee will construct a cell. With other insects and animals, and even with man himself the case is different. Insects will imbibe nourishment from the exudations of both animal and vegetable substances. Man can accommodate himself to every variety of diet, and thrive on all. The bee alone never changes its food. The sweet sap that exudes from vegetable pores, and which is accumulated from the nectary of flowers, serves alike to sustain the bee, and to render the seeds of plants fit for germination. As no flower can arrive at maturity without the assistance of this fluid, it is ever present; and as the bee has a two-fold duty to perform, that of preserving its own being by such means as Nature has pointed out, and that of assisting the winds in carrying the pollen from flower to flower, Creative Wisdom has so arranged it, that the peculiar food of the bee is in abundance. And as this nutritive fluid is to support inanimate life, which requires an unvaried and uniform food, the bee for ever partakes of the same nourishment, and is enabled to preserve its peculiarities of form and instinct unaltered, from generation to generation.

For both the operations, therefore, of sustaining life, and of dispersing pollen, which require uniformity of instinct and organization, the bee is the same in all situations, and in all ages. The working bees have the instinctive faculties of building different shaped cells, of choosing and preparing food both for the larvæ and for themselves, of taking care of the young brood, of carrying off noxious and extraneous matters, of defending themselves from enemies of *their own species*, and of expelling the drones when they are no longer of use in the hive. They have the instinctive knowledge that they cannot, as other insects do, exist individually; the cells are constructed therefore in so admirable a manner, as to make every thing subservient to the safety and comfort of the mother of the brood. She

is, in their estimation, as much a part of themselves as an eye or a limb. Their care of her is a kind of self-preservation, a law implanted in every living thing.

After rejecting all the fanciful and marvellous speculations of the theorists, there are still several material points unsettled, on three of which we propose to make a few remarks at the present time.

1st. The most modern and the most rational theorists differ in their opinion respecting the accuracy of the facts that are stated in relation to the queen bee leaving the hive at any other time, than when she goes forth with a new swarm.

2d. They dispute likewise on the possibility of the bees making a queen bee from a neuter, when circumstances require it.

3d. They are still ignorant whether the drones perform the office of nurse to the larvæ, when deposited in the different cells.

On the first point we venture to state unhesitatingly, that *the queen bee never leaves the hive but when she accompanies a swarm*. For ten weeks we fixed our attention on the entrance of two hives that stood close to each other on a bench. Our watch, either in person, or entrusted to another as interested and vigilant as ourselves, commenced at grey dawn, and continued till sun-set; and never, within that period, did the queen bee of either hive leave them but at the time of swarming, which occurred once in each hive during our inspection. With an eye to this single circumstance, we have, for six successive years subsequent to the careful observation just stated, been in the constant habit of noticing every peculiar movement at the entrance of the hives, but we never saw the queen. Independently of the reliance that can be placed on observations of this kind, we have confirmation derived from strong probabilities.

The average number of a hive or swarm is from fifteen to twenty thousand bees. Nineteen thousand four hundred and ninety-nine are neuters, or working bees, five

hundred are drones, and the remaining *one*, is the queen, or mother ! Every living thing, from man down to an ephemeral insect, pursues the bee to its destruction, for the sake of the honey that is either deposited in its cell, or secreted in its honey bag. To obtain that which the bee is carrying to its hive, numerous birds and insects are on the watch, and an incredible number of bees fall victims in consequence to their enemies. Independently of this, there are the changes in the weather, such as high winds, sudden showers, hot sunshine ; and then there is the liability to fall into rivers, besides a hundred other dangers to which bees are exposed.

Can any one, who considers all these casualties, suppose that the instinct in bees is so defective, as to allow so important a member of the community, and the only one of the kind too, to leave the hive, and run the immense risk that would attend an excursion in the air ? It is a well established fact, that one queen lays all the eggs of the hive ; that part of the daily duty of the working bees is to nourish the young brood, which if there was no queen they could not do, as there would be no eggs. If the bees are disturbed in their regular routine of business, they become uneasy and incapable of proceeding. When they return from the nectary of flowers with the usual quantity of sweet fluid, they hasten to bestow the first or uppermost part of the honey on the larvæ and young bees ; and when this simple undigested liquid is disposed of, they deposit that which has gone through a certain chemical process in the cells.

If, therefore, on entering a hive they find no queen, they run about anxious and distressed, drop the little pellets of pollen that are attached to their legs, strike their antennæ against one another, and are in great agitation during the day. Sometimes two days are passed in this restless state, before they make an effort to repair their loss.

If the queen bee were to leave the hive, as Huber and others fancy, she would run great risk in never being able to return to it. Even around the apiary, before she had

made the usual evolutions in the air, common to all bees on leaving the hive, she might become the prey of one of the many birds that are hovering over head, or on the watch; these swallow bees by dozens while on the wing; and the queen bee would have less chance of escape, as she is larger, and therefore more conspicuous; and is besides very slow and heavy in her motions, her wings being smaller, in proportion to her body, than those of the working bee and the drone.

From our own observations, therefore, as well as from the above inferences, we must believe that the queen bee *never* leaves the hive, but for the establishment of a new colony.

The next material point of dispute is, whether it be in the power of the working bees to convert the larva of a working bee into that of a queen, when by accident the hive is deprived of one. According to the most accurate naturalists, the organization of the queen, or mother bee, is different from that of either the drone or the neuters. It appears to us quite as rational and philosophical to suppose that a queen bee could be converted into a neuter, and therefore, that all bees at first were of the shape and organic structure of the queen, as to suppose that a neuter or working bee could have new organs added, new curves given to its limbs, and new instincts to its nature.

If we could see the interior of a hive whenever it suited our convenience, we should not be so lost in conjecture; but the irritability of these little insects prevents a constant and minute internal inspection. It is a part of their instinct to know that *light, heat, cold, and moisture*, in an undue and unaccustomed degree, are prejudicial to the formation of wax, to the consistence of honey, and to the health of the brood. They therefore use all the little arts and advantages they possess, to prevent any one from exposing them to the injurious influence of these active powers.

When a queen bee ceases to animate the hive, the bees

are conscious of their loss; after searching through the hive, for a day or more, they examine the royal cells, which are of a peculiar construction, and reversed in position, hanging vertically, with the mouth underneath. If no eggs or larvæ are to be found in these cells, they then *enlarge* several of those cells which are appropriated to the eggs of neuters, and in which *queen eggs have been deposited*. They soon attach a royal cell to the enlarged surface, and the queen bee, enabled now to grow, protudes itself by degrees into the royal cell, and comes out perfectly formed, to the great pleasure of the bees.

Now this in itself is curious and wonderful. There is no need of adding superhuman powers to an insect, when the simple facts show such singular sagacity. The truth is, that the queen, or mother bee, lays the neuter eggs in certain cells of a particular construction; in fact the eggs are laid, or at least many of them, as soon as the foundations are begun, before the cells are built. The bees know, from the peculiar shape of the egg, that it is to have a cell of certain dimensions. When the neuter and drone eggs are deposited, the royal cells are then filled; for abundant observations prove, that the queen eggs are laid last. If the royal cells are not sufficient to hold all the queen eggs, they are laid in the *common cells*; and in the course of the regular business of the hive, these cells are attended to with the rest. When the larva is of a size to fill the cell, a covering of wax is put on, and here ends the life, or rather the embryo of the queen; for no longer having room to expand, it perishes, and is dragged out in the nymph form, as soon as the bees discover that animation is extinct. If during the progress of the egg from the larva to the nymph state the mother queen dies, and there are no eggs in the royal cells, then the bees have recourse to the queen eggs that are laid in the common cells. By enlarging the entrance, and attaching to it a cell, which hangs *vertically*, they continue the life of the larva, and a queen bee is formed.

Here is no work of transformation. The insect is already formed, and nothing remains to be done, but the mere mechanical operation of building a habitation, which shall be adequate to its wants. The peculiar organic construction of the queen-bee perhaps requires a difference of food, as we perceive it does of dwelling. No doubt it is necessary to supply it more abundantly, and with greater care.

The very position it is compelled to take shows that it requires a different kind of nurture from either the common bee or the drone. It is wonderful that instinct is so competent to direct these changes; but it would be more than wonderful, if in addition to this instinct, the bee had the power to *construct new organs*, as it does different cells, and thus to endow the insect with a different nature.

The third point unsettled, and which is likely to remain for ever a secret, is, whether the eggs of the queen are hatched after the manner of fishes; whether they simply are animated by incubation, or by the care and nourishment bestowed upon them.

On this point experiment has proved nothing. The greatest diversity of opinion exists. There are upwards of a thousand writers on the history and policy of the bee, and yet no two have either observed or reasoned alike. Even the two distinguished naturalists, who have passed the best portion of their lives in studying bees, with equal zeal, and with equal opportunity, have come to very different conclusions. Huber is by far the most circumstantial experimentalist who has turned his attention to this subject. But his truly philosophical mind has been rendered comparatively useless, nay worse than useless, by the ignorance, or wilful misrepresentations, of his assistant, Francis Burnens. Huber could not but philosophize on facts as they daily were represented to him. His solutions of things *unreal*, and having *no truth in nature*, are most ingenious and rational. Had his physical sight been as perfect as his mental vision, his work would doubtless have been all that could be effected by the industry and talent of man.

The naturalists of Europe, misled by his extraordinary talent, adopted Huber's notions with respect to bees, and his opinions were considered as conclusive. The public opinion became imbued with the spirit of his doctrines; and we find the greatest and acutest reasoners discussing, in perfect security, the nature of an insect, that could at one moment organize animal life, and impart to it new instincts; and in the next, construct bulwarks and other modes of defence, to protect itself from an enemy, that until the last century never molested it.

The real fondness that was inspired for the study of the bee, by the interesting work of Huber, engaged many in the pursuit; and the very mistakes that he has made, have led to something nearer the truth. Owing to the general improvement in education, the taste for the marvellous is fast disappearing; and there are many who sit themselves down to the study with their reason unbiassed, and their judgment free to decide according to the evidence of facts.

Huish, amongst the late writers, has most successfully combatted the principal errors in Huber's theory; but although he has fixed a base on which a rational theory may be built, his object seems less to elicit truth, than to expose the errors of Huber. This he has endeavoured to do in the most unamiable and bitter spirit, which destroys the gratification with which his book would be read by the candid inquirer. In addition to this, he has laid himself open to plagiarism. He must have studied the subject sufficiently to acquire a knowledge of the different forms of hives that have been in use from the earliest antiquity to his own time; and the peculiar shape of the Greek hive could not have escaped his vigilance, for drawings and descriptions of it are within the reach of every student; yet he boldly states, that a flower-pot first gave him the idea of the plan which he adopted for his own hive.

We esteem it a very desirable object to make the care of the bee more common than it has hitherto been in this country. Never was there a country more suited to the

cultivation of bees. Even in August there is abundance of white clover, and small springs and shallow rivulets appear at every turn. There is no doubt that bees were formerly more frequently kept in America than at present. In many places in New Jersey, where there is now scarcely a bee to be seen, there once existed millions of these insects, to the great profit of their owners. It was common for one dealer in a country town to sell from fifteen to twenty barrels of strained honey alone, to say nothing of wax and comb-honey; as well as a kind of wine, made of the washings of combs called *metheglin*. These articles of commerce have almost disappeared; and we find that it is mainly attributable to the ravages of the millers, or night-moths, which have of late years spread destruction through the hives.

The attention of the naturalist has been directed to the history of this fatal enemy of the bee, and many attempts have been made to construct hives that would prevent the millers from depositing their eggs in them; but the plans were defective, because there was no contrivance for inspecting the hives.

Before we close this article, we will endeavour to give a description of a hive, that is so constructed, as to enable any one to see the interior, and to free it from all extraneous matters, as well as to protect it from the inroads of the night-miller.

On the general subject of the care of bees, the following remarks, the result of experience, may be acceptable to the reader.

The situation of an apiary is of little importance. We have seen bees thrive as well with an eastern as with a northern aspect.

If the entrance of the hive face the north, the bees may possibly be detained within a minute or two later in the summer; but this is more than overbalanced, by the same cause operating in winter, when it is desirable that the bees should remain in the hive. But for ourselves, we have

seen no difference in the time of quitting the cells, between those that faced the north, and those that had a southern exposure. Nor have we observed that there is any difference in the welfare of hives, as placed in vallies, or elevated on hills; meaning, of course, hills of thirty or forty feet in height.

We have seen hives prosper, oftentimes, near a pig-sty. We have known colonies of bees to exist for a term of twenty years, with no other protection from the heat and cold than the tops of the hives. They have multiplied equally well under an open shed; but as a free circulation of air is necessary to their health and comfort, so we have never known them to thrive when quite enclosed. A house, therefore, strictly so called, which is shut on all sides, may serve to amuse the observer for a year or two; but there must be an extraordinary combination of fortunate circumstances, if the bees increase while confined in it.

It is better to begin with a single hive, and to attain a knowledge of the habits and instincts of the bees by degrees. We have known several persons, who have purchased a number of hives at once, and relinquished the pursuit, from the perplexity that ensued when the swarming season commenced. But there is no similar occupation so easily followed, and none that requires so little capital, as that of keeping bees. The profit is enormous. If a person, well trained to the employment, should follow the plan adopted in some parts of Europe, of removing the bees from place to place, in a kind of boat or ark, on a river of some length, thus providing a plentiful supply of food, he might increase his stock to any extent.

An apiary of twenty hives, could maintain itself in an area of a mile, where there is plenty of blossoms. Every farmer should, however, provide pasture for his bees, as well as for his cows; and therefore, when the spring and summer flowers are gone, he should have a field of buckwheat ready; which, although not so palatable as other flowers, will serve the bees for winter food.

An apiary, or bee-shed, should be, at the eaves, about four feet from the ground, with a roof sloping both ways, and with any aspect that the owner chooses. It should be ten feet wide, and the length of it should be increased as the hives multiply. It is, however, difficult to describe one accurately.

The most convenient one that we have ever seen, is on a farm near New Brunswick, in New Jersey. It is fifty feet long, and contains sixteen hives on each side. The swarms which are successively cast off, are placed under the same shed in the winter, and an equal number of the old hives are sold to make room for them. This apiary might be enlarged to any extent, were there pasture enough for the bees; but the area of the bees' flight, as there are now many cultivators of bees in this district, does not furnish food enough for a great number.

In this apiary, the miller, or night-moth, is successfully guarded against. A small wire door, formed of needles, and made to slide behind two door-posts, is closed over the entrance of the hive, as soon as the bees have retired for the night. This is done during the months of April, May, and June; after that, if the weather sets in warm, and the bees are oppressed by heat, the floor of the hive is let down; which, as it is fastened to the hive behind with hinges, and on the sides with hooks and staples, can easily be accomplished. Two rows of scantlings, or joists, four inches square, and running the whole length of the apiary, receive the hives between them, which are thus suspended at a distance of three feet from the ground.

The hive is thirteen inches square at the top, and is of the same length at the bottom of the front and back; but the bottom of the sides is only seven inches wide. By thus sloping the sides of the hive, the combs wedge themselves as they are made, and there is no occasion for the ill contrived crossed sticks, that are generally thrust in the old hives, to keep the combs from falling down by their own weight. The floor is, as we have observed, fastened

by hinges and hooks. It is likewise an inclined plane, having a slope towards the front of at least four inches.

The advantages of this slope or inclination will be instantly seen. The perspiration of the bees, which is copious, is, by the inclination of the sides and floor, conveyed off at once, without being absorbed by the boards. All extraneous matter can be carried away by the bees with very little trouble; and they can defend themselves from corsair or robber bees, with much greater ease than if the floor was level.

As the floor opens and shuts, so the observer can inspect the interior of the hive at pleasure; not indeed with the hope of getting at the minutiae of the bees' policy, but to see the forwardness of the combs, the number of the bees, and the general appearance, which a practised eye can soon understand. When the floor of the hive is left down all night, and the bees hang very low from the combs in the morning, they will soon raise themselves up again, if the floor is lifted very gently and slowly, and fastened as usual.

The cover of the hive is, of course, thirteen inches square. It is made of common pine, as is the hive, with two cleats on the upper part, as well to prevent the board from warping, as to prevent the box, or upper story, which is always added, from being moved from its place. The cover of the hive has three holes made in it, of one inch in diameter, within a quarter of an inch of each other. These holes are to allow the bees to pass to the upper box, when the *hive* is full of honey.

It is ascertained, satisfactorily, that the young brood, and the bee-bread, or pollen, are deposited in the hive where the swarm is first put. The holes in the cover are, therefore, kept shut by plugs, until the hive be filled. The holes are then opened, the bees immediately pass up, and if the season be propitious, they fill the upper box with combs and honey, which, as there is neither brood or bee-bread, is of the finest and purest kind.

We have often seen forty, and even sixty, pounds obtained by this simple proceeding; and the box is also used to feed a famished hive in the spring. A single comb left in one of these boxes will sustain a swarm that has eaten up all its honey, until vegetation commences. As the boxes and hives are of equal size, any one box will fit a hive.

When the combs in the hive are three years old, two of them can be taken out every winter, provided there remains honey enough in the nest for the use of the bees. Thirty pounds weight of honey is the average quantity that suffices for a swarm of a large size. The hives in question, weigh when empty, about twelve pounds, a swarm of bees four pounds, the wax two pounds; the whole, therefore, ought to weigh about fifty pounds in November. All above this quantity can be taken out with advantage, as the wax becomes very dark after two or three years. The whole of the combs can be renewed in the course of four years, as the bees replace them early in the spring. We omitted to mention that the height of the back of the hive is twenty-two inches; and of the front, twenty-eight inches; and also that the floor projects in front about three inches; thus forming an apron, or platform, on which the bees alight before they enter in at the little door. Models of this hive have been sent to several of the Horticultural Societies of Europe, and they are getting into use in this country.

When a swarm is to be hived, the hive is put in a moveable frame, which is easily carried to the tree where the swarm hangs, and this is proved to be the best method of hiving swarms; as the screws are taken out of the cover, and the hive lifted up to the swarm, into which they are shaken. The frame and hive are then placed on the ground, and the cover is then *gently* laid on, and screwed fast to the hive. Small sticks are put against the apron, and rest on the ground, serving for those bees to ascend that fell to the ground when the main body was shaken

into the hive. Bees, from the moment of their leaving the hive, when swarming, until they are fairly settled, and at work in their new habitation, seem stupid and confused. This arises, however, from the precarious situation of their queen. If she fall into the hive when the swarm is shaken in, all the remaining bees will soon find their way to the entrance; for a peculiar sound is emitted by these insects when their queen is present. If, however, she remain on the limb, it will be necessary to shake it again over the hive, as the bees will leave it to fly up to the place where the queen is. When the bees are quiet in the hive (which is ascertained by the number that are seen hovering in front of the entrance, on the wing, and the others ventilating the hive with their wings) the top can be covered with a sheet, doubled several times, to keep off the heat of the sun. The hive must remain in the same spot until eight or nine o'clock in the evening, when two persons can quietly and gently convey it, frame and all, to the apiary, and place the hive, with great care, between the joists, where it is permanently to remain.

Hives should be made and painted a year before they are used, as the smell of paint is disagreeable to the bees.

The smoother the boxes and hives are made, inside and outside, the better for the health of the bees, and for preventing the depositing the eggs of the miller-moth. We must except, however, the insides of the *roofs* of the hive and the box, as they should be rough; for we have ascertained, that the propolis, or bee-glue, does not adhere so closely to a smooth surface at all times\*.

\* There is still required more information concerning the construction of these hives and boxes to enable us to employ them. The American Editor, indeed, refers us to examples of such to be seen there; but as we cannot avail ourselves of this aid, we shall endeavour to supply those deficiencies, as far at least as we are enabled to do so. It appears then to us, that the bottoms of the boxes are to be left entirely open; and instead of being inclined like the bottoms of the hives, that they are to be level, or parallel to their tops; but that their sides are to be contracted, like those of the hives, in order to retain the combs in their places. We also suppose, that in order to support the hives between the joists of the apiary, they must have cleats affixed to their back and front sides, near their upper ends, for them to rest

And here we would remark, that it has been the custom, from the earliest ages, to rub the inside of the hive with a handful of salt and clover, or some other grass, or sweet-scented herb, previously to the swarm's being put into the hive. A clean cool hive, free from any peculiar smell of mustiness, will be acceptable to the bees; and the more closely the hive is joined together, the less labour will the insects have, whose first care it is to stop up every crevice, that light and air may be excluded. We must not omit to reprehend, as utterly useless, the vile practice of making an astounding noise, with tin pans and kettles, when the bees are swarming. It may have originated in some ancient superstition, or it may have been the signal to call aid from the fields, to assist in hiving. If harmless, it is unnecessary; and every thing that tends to encumber the management of bees should be avoided.

(To be continued.)

upon; and likewise, that the spars or joints themselves must have cross-pieces affixed between them, in the intervals between the hives, to prevent them from yielding or giving way. With these additional remarks attended to, we conceive that this arrangement would prove a very convenient one.

EDITOR.

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LVI.—*On Explosions in Steam Boilers.* By Dr. THOMAS P. JONES, Editor of the *Journal of the Franklin Institute*.

THE following notice of an explosion of a steam-boiler, recently appeared in the *Pittsburgh Gazette*, and has been republished in most of the papers in the United States:—

“*Explosion.*—On Tuesday night, about nine o'clock, one of the steam-boilers of the Union Rolling Mill (iron works) at the eastern extremity of Pittsburgh, on the Monongahela river, burst, with a tremendous explosion, shot off through the air, at an angle of about 45 degrees with the horizon, and describing a beautiful arch, fell into the river about two hundred yards from the works. *The steam being on fire*, and issuing from the boiler in a stream of flame, it was beheld with astonishment and ad-

miration by the passengers on board a steam-boat, which had but a few moments before passed the spot where it descended. The furnace, in which four boilers were situated, being placed without the wall of the main building, under a slight shed, and the exploding boiler taking a direction outward of the works, no other injury was sustained, than the present loss of the boiler itself, and the displacing of the three others, which it threw entirely out of the foundations, and beyond the floor on which they were erected. The rolling apparatus alone is stopped by the accident; the hammers and other works were in operation as usual on Wednesday morning."

With respect to the cause of such explosions, there is not, by any means, a concurrence in opinion, even among scientific men; and the manifest importance of the subject, renders valuable every new fact relating to it, which can be established upon incontrovertible evidence. That highly elastic steam will cause a boiler to burst, and that most of the accidents of this kind which occur, arise either from the want of strength in the boiler, or the imprudent confinement of the steam, is admitted on all hands; but it has been believed by many, that in those tremendous explosions which occasionally occur, such as that above recorded, the exploding agent is, in part at least, a mixture of those gases whose bases combine and form water, and that there is an actual combustion of these within the boiler. For ourselves, we have never for a moment entertained such an opinion; and although we have found among its advocates some persons not unacquainted with chemistry, we have never met with, or been able to elicit any admissible rationale of the formation of such a mixture; nor do we recollect, among the accounts of such explosions as have appeared, any one, except the foregoing, which seemed to justify the opinion of a gaseous combustion. Whether the evidence in this case before us, possesses sufficient strength to add probability to this opinion, we shall presently inquire.

In our second volume, page 147 \*, there is a letter to the Editor, from Professor Hare, in which he has examined this subject, and drawn the conclusion, that the production of explosive gases is contrary to the well established principles of chemistry. To this article we refer our readers.

A valuable paper, by Mr. Perkins, on the same subject, may be found in our third volume, page 417 \*. We thought there was great force and consistency in the theory of that gentleman, and we have not yet seen any reason to change this opinion. We do not think it necessary to repeat what was there said, as it is in the hands of our subscribers. Those who feel an interest in the inquiry may turn to it with advantage.

In the Pittsburg account, the idea of the burning of the steam, is no more rational than would be the apprehension that it might "set the river on fire." Steam is as incombustible as water; indeed, it is water in an attenuated state. The opinion, that steam itself burns, when water is thrown upon combustibles, appears to be one of those vulgar errors which are the result of trusting too much to the senses; those principal but often false guides of the uninformed. When water, in moderate quantities, is thrown upon a brisk and flaming fire, it is converted into steam; which, expanding and mixing with the flame, causes it to spread out into a much larger volume than it would otherwise have occupied, and thus *apparently* increases the combustion. If it acted in any other way than that stated, the water must be decomposed and recomposed at the same instant; and how, in that case, it could increase the heat, we should be puzzled to tell.

Passing over the statement of the burning of the steam, as only evincing a deficiency in chemical science, which is by no means extraordinary, or disreputable, we can well imagine how the appearance of that combustion was pro-

\* See Vol. II. of the *Technical Repository*, page 55.

† Same vol., page 294.

duced, which, had it really existed, would have proved the formation of explosive gases within the boiler. We are of opinion that the boiler was heated to redness at one end, and that the meteor-like appearance which it exhibited, was merely the rapid passage of the projected boiler through the air. To the eye, this, like the whirling of an ignited coal, would present a lengthened stream of light, and apparently justify the conclusion, that there was a real combustion.

Had this accident, or any of those similar to it which have occurred on board of steam-boats, been the consequence of explosive gases, a volume of flame would have filled the vessels; linen, and other light articles, would have been set on fire; and persons, instead of being scalded by steam, would have been scorched by fire.

As regards the force of explosion, there is no reason why it should not have been produced by steam alone. If the steam-gun, constructed by Mr. Perkins, should never be brought into actual use, it will have evinced, experimentally, that projectiles may be thrown by the elastic force of dense steam, with a power equal to that of gunpowder. It is not necessary, therefore, in order to account for the effects produced, to resort to any other agents than those which are known to be present heat and water.

If we ever seek to devise means for obviating such accidents as those of which we have been speaking, we must first acquire correct information respecting the facts attending them, and not adopt vague assumptions as admitted truths; we must either proceed upon established principles, or discover reasons for correcting our theory. Before assuming that the ignition of gases is concerned, let us hear how these gases are produced. If the oxygen of the water could be made to combine with the iron of the boiler, the hydrogen would be altogether incapable of producing an explosion, without admitting a large portion of atmospheric air; which air must find its way into a vessel, in which there was a large quantity of vapour and gaseous

matter, in a state of tension, and exerting a pressure outward, much greater than that of the external air.

It is believed that these violent explosions take place only when the boiler is without its proper supply of water. If such be the fact, the desideratum is the means of always furnishing this supply; an object which does not appear to present any insurmountable difficulty.

We invite attention to this subject; and particularly desire of those who have studied chemistry, and who advocate the opinion we have opposed, to explain the process by which they imagine a boiler can become charged with oxygen and hydrogen, or any other explosive mixture of gases.

*Additional Remarks by the EDITOR of the Technological Repository.*

There seem yet to be wanting other particulars, to enable us to form an exact idea of the causes and effects of the above-mentioned explosion. For we can have no idea of an *entire boiler* being projected from its seat to the distance of two hundred yards. We indeed well recollect the explosion of a steam-boiler at Smitherman's saw-mills, in the Borough, many years since; and when the top, sides, and ends of the boiler were torn away from its bottom, by the force of the explosion, and were projected much in the way above described; and no doubt would also have been thrown as far as in this latter instance, had not their progress have been stopped, by their coming into contact with some bags of hops, which were contained in the upper story of a lofty warehouse, and through the roof of which they had made their way. The bottom of the boiler was indeed likewise removed from its foundation, but was only carried a few yards in the same direction with the other parts of the boiler.

LVII.—*On Interesting British Objects of Nature and Art.*

We extract the following judicious observations from the 85th Number of the *Quarterly Review*, for July, 1828.

“Under all circumstances, a befitting portion of time and attention should be devoted to the survey of all that England so largely furnishes to the eye of intelligent curiosity.

“This latter topic is one upon which we might easily dilate; and the temptation is greater to do so, from the want of some work which might serve as an adequate guide to the traveller in Great Britain. We should find pleasure, did our limits allow of it, in suggesting some form of outline for such a work. But as this would engage us too far on a new ground, we must be content to indicate merely a few of the greater objects of research, to an English traveller in his own country.

“To the geologist, Great Britain offers an epitome of the world. With the exception of real volcanic formations, and certain subordinate members in the series of rocks, few points of geological illustrations are wanting to us; and some, as in the case of the coal, oolitic, and chalk formations, are more abundantly afforded than in almost any other country. Our mining districts are remarkable for their number, and the variety of their products. Within the limits of the island, nearly twenty separate coal districts are known, and in actual working. The vast, we might almost say vital, importance of these mines to the prosperity of England, is too well known to need remark. Our mines of copper, lead, iron, tin, and rock-salt, have also an extent and value in the national economy, which render them well worthy of observation: and we may farther add, that no country has contributed more to enrich with the animal organic remains of former worlds, that great field of discovery, first brought to the character of a science by

Cuvier, and since zealously and successfully cultivated by British geologists.

"To those interested in the mechanical sciences, and the application to manufactures and the arts, England offers a larger scope of observation than any other country in the world. Throughout the vast establishments of our iron, cotton, woollen, linen, silk, and hardware manufactures, there is even less to create astonishment in the multitude and variety of the products, than in the exquisite perfection of the machinery employed—machinery, such in kind, that it seems almost to usurp the functions of human intelligence. No one can conceive its completeness who has not witnessed the workings of the power-loom, or seen the mechanism by which the power of steam is made to effect the most minute and delicate processes of tambouring. Nor can any one adequately comprehend the mighty agency of the steam-engine, who has not viewed the machinery of some of our mining districts, where it is employed on a scale of magnitude and power unequalled elsewhere. In Cornwall especially, steam-engines may be seen working with a thousand horse power, and capable (according to a usual mode of estimating their perfection as machinery) of raising nearly 50,000,000 pounds of water, through the space of a foot, by the combustion of a single bushel of coal\*! No Englishman, especially if destined to public life, can fitly be ignorant of these great works and operations of art, which are going on around him; and if time can be afforded in general education for

\* "It is a remarkable proof of the amount of improvement effected in some of the Cornish steam-engines, that the result obtained from a given quantity of coal, estimated in the manner alluded to above, is nearly three times as great now as it was twenty years ago. Nor will the spectator find more cause of astonishment in the magnitude of these engines, than in the order or even beauty of every part appertaining to them. The furniture of a drawing room is not more scrupulously arranged, or preserved in a state of higher polish, than these huge representatives of human power."—We entirely agree in the truth of these remarks; and we may add, that besides, we have seen advantage taken of the heat arising from the steam-engine, to convert the glazed roof of the engine-house into a green-house! EDINBURGH.

Paris, Rome, and Florence; time is also fairly due to Glasgow, Manchester, Leeds, Birmingham and Sheffield.

“Nor, speaking of the manufactures of England, can those be neglected, which depend chiefly or exclusively on chemical processes. It may be conceded, that the French chemists have had their share in the suggestion of these processes; but the extent, variety, and success with which they have been brought into practical application in England, far surpasses the competition of any other country. These are, perhaps, from their nature, and from the frequent need of secrecy, the least accessible of our manufactures to common observation; yet they nevertheless offer much that is attainable and valuable in research, to the intelligent traveller.

“Connected with our manufactures, are the great works of the civil engineer, which cover every part of England; the canals, roads, docks, bridges, piers, &c.; works, which attest more obviously than any others the activity, power, and resources of the country. Amidst their multitude, it would be impossible to pursue even the slight sketch we are now giving; and the less needful, from the great familiarity of the objects themselves. Yet even these, though more familiar to observation, are much less generally known than they merit to be. They are for the most part seen rather as matter of chance, than studied as monuments of art, or as ministering largely to public utility. Our system of canal navigation, with all its great works of reservoirs, tunnels, aqueducts, locks, and embankments, might alone form the subject of long and interesting study; and has, in fact, been made so by M. Dupin, whose writings have done so much to illustrate the superiority of England, in this, and in all other modes of internal intercourse. If called upon to propose any summer's journey for a young English traveller (and it is a call often made with reference to Continental tours), we might reasonably suggest the coasts of Great Britain, as affording every kind of various interest, which can

by possibility be desired. Such a scheme would include the ports and vast commercial establishments of Liverpool, Bristol, Greenock, Leith, Newcastle, and Hull; the great naval stations of Plymouth, Portsmouth, Chatham, and Milford; the magnificent æstuaries of the Clyde and Forth, and of the British Channel; not surpassed by any in Europe; the wild and romantic coasts of the Hebrides and Western Highlands; the bold shore of North Wales; the Menai, Conway, and Sunderland bridges; the gigantic works of the Caledonian Canal, and Plymouth Break-water; and numerous other objects, which it is beyond our purpose and power to enumerate. It cannot surely be too much to advise, that Englishmen, who have only slightly and partially seen these things, should abstract something from the length or frequency of their Continental journies, and give the time so gained to a survey of their own country's wonders of nature and art."

"*Note.* It is remarkable enough, that there should not exist, at this time, one tolerable guide-book to our own country. We have itineraries, indeed, which give faithful record of miles and furlongs, of market towns, and country seats; and sundry neat volumes, which treat of the wells, and other wonders of each of our many watering-places; but a fair index to England, in its present state, we do not yet possess. Although more objects, worthy of note and research, present themselves in this small surface, than on any equal extent in the world! If a young Englishman desire to see thoroughly his native country (a desire we would fain render more frequent), or an intelligent foreigner arrive with the same intent, we know no single work, scarcely any set of works, to which we could conveniently refer them, as aiding their object. The many volumes of tours, English, Scotch, and Irish, which appeared during our exclusion from the Continent, even if possessing more original merit than they generally did, are all antiquated and useless. The growth of England in arts, manufactures, agriculture, and public works, has been far too mighty, to be kept within the compass of these ephemeral writings; which, indeed, have chiefly concern with the natural beauties of the country. The works of an eminent foreigner, M. Dupin, which we have had occasion before to recommend to our readers, form in fact the best modern guide to the scientific traveller in England; limited, it is true, by the particular purposes of the author, but still affording a body of useful information, accurate for the most part, and well arranged, such as cannot readily be found elsewhere.—This reproach ought, on every account, to be removed from us. Not, however, by a mere bookseller's compilation, the *crambe recorta* of obsolete volumes; but by an enlightened and scientific work, the fruit of intelligent observation, and collected from the best sources. We should desire to see a book, having the same excellence as a general English guide, which Conybeare and Phillips's *Geology of England* possesses, in its particular department."

LVIII.—*On Portable Horse Mills.* By M. AMEDEV  
DURAND\*.

THE horse is attached to the extremity of a cast-iron lever, which puts in motion a large horizontal wheel, the upright axis of which is sunk into the earth, and having a groove around its rim, which is armed with points of iron; these points enter the links of a chain, which passes around the great wheel, and through two cast-iron trunks, or tubes, which are buried in the earth, under the horse-walk; this chain very conveniently communicates the motion to any distance, and in any direction required; and either of each may be varied *ad infinitum*, without much loss of time, or the employment of any considerable quantity of materials. This is, however, by no means the case in the removal and erection of the ordinary horse-mills. A certificate, given after two years' experience of their use, shows, that two men only were able to re-establish them in the course of an hour, in a fresh situation in the open air; and where they constantly and completely performed their work, without requiring any repairs.

The idea of communicating motion under the horse-walk, is not, however, new, as a horizontal axis, and toothed-bevel wheel-work produce this effect in the ordinary horse-mills. But independently of the complication of this wheel-work, and the impossibility of employing it without shelter, it also requires to be established with great solidity; and which, when we consider these as portable horse-mills, cannot be executed without a great expenditure both of time and materials, as each fresh establishment brings with it the necessity of fresh mounting the wheel-work with a rigorous exactness, in order that their teeth may act well in each other. It may likewise be remarked, that a horizontal axis can hardly transmit the motion to any great distance, whereas the chain may be indefinitely prolonged.

\* From Ferussac's *Bulletin Technologique*.

The employing of a chain with common oval welded links, is also an advantage; as it may be procured any where, and it may be repaired at any time, by means of spare links, not welded, and which require no great exactness on their surfaces.

The new horse-mills, which we have thus described, are exceedingly portable, as the work of two men, for an hour, is sufficient to establish one of them on a new foundation; but it is better, however, previously to construct in a pit, sunk into the earth, a frame-work, composed of pieces of wood, united at right angles to each other, and which may be effected at a trifling expense; and then, at the moment of removing the mill, there is nothing else to be done, than to carry away the great wheel and other parts; and which can be readily done upon a wheelbarrow!

The horse is attached to the outer end of the lever, by means of a swingle-tree and traces, which should be as short as possible. This is not indeed the best mode of doing it, as the point of attachment ought to be in the middle of the horse's back, and be effected by means of an iron arch. But the inventor prefers to affix the horse in the above mode, from the results of his experience; and he observes, that this method does not produce any ill effects, when horses are employed that have not been used to this work, but only in the conveyance of passengers.

In case of applying the horse-mill to actuate an Archimedean screw to raise water, and which screw is placed at an angle of about forty-five degrees, the movement is first transmitted horizontally from the great wheel by the chain, which, as abovementioned, passes through two cast-iron trunks placed under the horse-walk, and thence under two guide-pulleys, placed at a proper angle to lead the chain around a grooved wheel, with points to it, and which is affixed upon the upper end of the axis of the Archimedean

screw. One of the guide-pulleys is mounted in a frame, affixed firmly to the basis or frame-work of the machine; but the frame of the other guide-pulley is jointed at its lower end to that frame-work, and has a horizontal arm or lever affixed to its upper part, upon which a weight can be slidden backwards or forwards, to adjust the tension of the chain at any time. The moveable, or adjusting pulley, as well as the fixed one, is always to be placed at an oblique angle, which the tension of the chain naturally indicates.

A similar contrivance to the above will also answer, when conveying the movement to a horizontal axis. But when it is requisite to communicate motion to a vertical axis from the great wheel, then the tightening guide-pulley, which is the only one necessary to be used, must be mounted in a frame so as to swing horizontally; and which can be drawn sideways, so as to produce the necessary tension to the chain, by means of a cord affixed to it; and which cord, passing over a pulley, has a weight affixed to it.

*Copy of the Certificate.*

“I hereby certify the following facts:—Two portable horse-mills, made of cast and wrought iron, the invention of M. Amédée Durand, were employed at the works carried on at the port of St. Ouen, during the years 1827 and 1828, in actuating the apparatus for mixing the materials used to form mortar. These mills always worked in the open air, and have never required any repairs up to the present time. Their removal and re-establishment have always been so quickly performed, that two workmen could always effected it in an hour's time, and without requiring the aid of any other tools than a pick-axe and a spade, or any other materials than the earth found upon the spot. These mills have always performed their work in a most satisfactory manner, although continually left to

*On the Substitution of Plumbago for Oil, &c.* 373

the care of mere labourers, and exposed to all the accidents, which are inevitable in the midst of such great works."

*Port of St. Ouen,  
Nov. 16, 1828.*

A. GEGEMBRE, *Architect.*

*Remarks by the EDITOR.*

An endless chain, formed of stout oval links, and actuated by means of a grooved wheel, armed with points, which enter into the links, and which wheel is driven by the steam-engine, &c., has been long and successfully employed in this country, in drawing lead pipes, to carry forwards a carriage hooked to it, and which carries the triblet, and the cast leaden cylinder to be drawn into pipe; and we are glad to find that it has also been equally successfully used in other works, as appears from the above highly respectable certificate. We trust it will therefore now be more generally employed than heretofore.

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LIX.—*On the Substitution of Plumbago for Oil, in Chronometers.* By Mr. L. HERBERT\*.

SIR,

3, Queen's Terrace, Queen Street, Chelsea.

PERMIT me to offer you a few observations upon a subject, which fifteen years of experience have produced; namely, the substitution of plumbago for oil in the rubbing parts of chronometers, in order that they may be laid before the Society of Arts; and thus, if approved, become beneficial to the world at large.

The use of sidereal and mean-time pieces in observatories at sea or on land, is to measure the motions of the heavenly bodies, and by them ascertain their right ascension in time, their distance from a given point, and to obtain the longitude of places upon the earth. From that

\* From Vol. XLVI. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The Society voted its gold medal to Mr. Herbert for this discovery.

the word *chronometer* (measurer of time) is derived ; but very few deserve that appellation. Whatever may have been the skill of the maker, and the care he took for their perfect construction, the observer must not expect to find them infallible ; and however well regulated they were at first, they will not remain so permanently. Their rate of going will be accelerated or retarded by the temperature of the atmosphere, which causes all metals to expand or contract, more or less, and that in an irregular degree, will create a variation in their movements ; and though innumerable experiments have been tried to render them perfect chronometers, by compensating pendulums or balances that might contravene the atmospheric influence, yet none have been found that would accomplish that desideratum ; because it is evidently proved, that metals, after having been acted upon several times by heat and cold, never return to their primitive state at the same temperature.

But, sir, this is not the only difficulty chronometer makers have to combat against ; there is another powerful enemy which is always baffling their success, that is *oil*. The different degrees and fluidity of that liquid, are also great alterants of clock-movements. In hot climes it will become absorbed, in cold weather it will congeal, and in both instances impede the freedom of motion. This, nevertheless, may be remedied by a substitute, which I discovered about fifteen years ago ; and in order to befriend science, I will here name it, and explain the way of applying it to time-pieces, for the benefit of those who do not mind a little trouble, and have patience enough to go through the process it requires. It is *plumbago* ; which, when carefully used, will last a considerable time, without the necessity of being renovated. But much depends upon its quality. It must be of the best kind, free from grit, and the tenderer the better. A spurious sort would endanger the holes and pivots, causing mischief instead of preventing it. The purest I could procure was from the

late Mr. Langdon, who was the first pencil-maker in London (perhaps in the world), Great Russell Street, Bloomsbury; who, after I had explained to him the purpose it was intended for, considered its choice of the utmost importance, and selected some of the best, which answered my utmost expectation. I applied it to my sidereal time-piece in January 1816. Since that time, *it has been cleaned three times, without the plumbago being renovated.* The friction places were only wiped over with a fine piece of muslin; and now, in 1827, it goes as well as ever!

I must beg to observe here, that I then found an insurmountable difficulty in charging the jewelled pallets of the escapement with the plumbago; but I obviated that, by applying it to the friction-planes of the teeth of the swing-wheel; and so, ever since, the clock has gone without oil.

The process of preparing and applying the plumbago is as follows:—Take about a quarter of a pound of the purest black-lead, the brighter the better; reduce it to a very fine powder, in a metal mortar; and to judge if it is fine enough, take a small pinch of it between the fingers; after rubbing it a few seconds, if it does not feel lumpy and gritty, but smooth and oily, it is good, and ground enough; have then a glass, full of filtered water, take up some of the ground plumbago upon the clean blade of a knife, spread it on the water, and stir it well, cover the glass, and let it stand for two or three hours; upon the top of the water there will swim a kind of film, skim it off with a card, and lay it upon a sheet of paper; when dry, put it into a box, to exclude the dust from it; put the sediment aside. Repeat the process, with some other water and ground plumbago, until you have acquired a sufficient quantity of the fine powder for your purpose. When the whole of the powder is become dry, grind it again in the mortar; or else bruise it with the back of the bowl of a silver spoon upon a clean sheet of paper, and repeat this process two or three times. If the black-lead is pure, no more sediment will go down; but if some does, wash and dry it once or

twice more. As soon as no sediment falls, you may be sure that the plumbago powder is pure, and cannot cause any mischief to the pivots and holes. Then pour some alcohol (the strongest spirit of wine) into a small glass, and having previously wiped the pivots of the wheels, and the holes in the plates, very clean, immerse them first into the alcohol, and then immediately afterwards into the plumbago powder, and they will be covered with it; then take a small brush, or hair pencil, such as is generally used by the miniature painters, dip it into the alcohol, and fill the pivot-holes with it; then introduce some of the plumbago powder into them with the finger, by rubbing the plates over the holes, till the powder fills them even with the surfaces; next put in the pivots of the wheels, and make them revolve in the holes in the frame for five or six minutes; do this to the pivots of every wheel, and also repeat it two or three times. The holes and pivots will thus become charged with a thin crust of plumbago, smoother than any polish which can be otherwise given to them; *the time-piece will go twice as long without cleaning as when oil is used*; and indeed, if its movement be entirely secluded from dust, there will be no occasion for cleaning it for twelve years! After that period the plumbago should be renewed.

The sidereal time-piece, to which I have applied the plumbago, was made with my own hands; and as its rate of going has been astonishingly good, and it is the only one of the construction ever seen, so I will give you a short description of it:—It goes eight days; the movement is not very different from others, except that the swing-wheel is at the bottom, and outside of the plate, supported by a steel cock. The pivot-holes of the swing-wheel and the pallets are jewelled. The escapement is fixed upon the pendulum, and swings with it. Its pallets are susceptible of a horizontal and vertical adjustment, by means of three screws; they lock and unlock the wheel of fifteen teeth at the diameter. The vibrations of the pendulum, between

the locking and the unlocking, are made in an arc of one degree and ten seconds, as marked upon the index plate; and the full swing is one degree and thirty seconds, making an excess of ten seconds of a degree on each side.

The clock is fixed to a cast-iron plate, fastened on the back of the case, and is adjusted in beat by two screws, acting laterally. The pendulum, which has three bobs, is suspended upon a *potence*, fixed at the back of the case. It has three arms; its perpendicular arm is seven inches long, and rests upon a stud at the bottom even with the pallets; its expansion is upwards, and it acts as a compensation for the length of that part of the pendulum which is between the suspension and the pitching of the pallets into the wheel. Upon the horizontal arm of the *potence*, and over the slit, is a screw-nut, by which the pendulum is hung; it serves to adjust the depth of the pallets in the swing-wheel. The pendulum spring is one inch broad, and its greatest flexibility is at a hole, three quarters of an inch wide; below the spring, at about six inches and a half from its most pliable part, is a plate, to which is affixed the escapement, having a perpendicular slit in the middle, wide enough to admit the cock of the swing-wheel through it, and to let the pendulum vibrate; to this plate is screwed a steel rod, at the end of which slides the pendulum-bob. Above the bob, and from its sliding-piece, branch two arms, with elbows, having a slit at each end, to admit the pivots of two levers, which support the thermometer bobs. On the steel rod is a brass tube, whose calibre is just wide enough to admit the rod, and to slide freely over it; this tube is fastened to the rod at its upper end; so that, by its expansion or contraction, it causes the two thermometer bobs to rise or fall; whilst, at the same time, one acts in a contrary way, and consequently produces a compensation. These bobs weigh three pounds each, including one pound of mercury in each of the phials, which are inlaid at the backs of them; they slide laterally upon their respective levers to adjust

the compensation. The time-bob weighs five pounds. The clock has no pulley; the weight itself, which is only ten ounces, acting as one. It has even gone with *five ounces only*, during six months! When I had a fixed observatory in Vauxhall Walk, the clock was often proved eight or ten times a day, by the transits of the sun and stars, when the atmosphere admitted; and in the last six months, and after all the improvements I deemed necessary were made, viz. from July 19 to Feb. 24, it never varied above thirty-six-hundredths of a second from its rate!

Such have been the happy results of my experiments; and I have no doubt that such exactness in the going of the time-piece was owing, not only to the correctness of its compensation, but also to the stability of motion produced by the use of the *plumbago*. I am aware that, to those who are averse to employ care and attention, the above process will appear troublesome; but, sir, what is a day's labour once in ten years? Let those, then, whom the love of improvement, and their own reputation, stimulates, try it, I am confident that their endeavours will be crowned with success. And with the pleasure of having greatly contributed to the benefit of mankind,

I am, sir, &c. &c.

L. HERBERT,

*Geographer at the Colonial Department.*

To T. HOBLYN, Esq.,  
Vice President, &c. &c.

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LX.—*On Purifying Linseed and Rape Oils.* By Mr.  
THOMAS COGAN\*.

OF the seed oils, those which are in the greatest demand are from rapeseed and linseed. In France, and in most other parts of Continental Europe, rapeseed oil is that

\* From Vol. XLVI. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce, just published. The Society voted its silver Isis medal, and ten guineas, to Mr. Cogan, for his discovery.

which is generally used for lamps ; but it will not give a clear light till it has been freed from the mucilage and other matters, which when heated become charred, and thus load the wick, and by obstructing the capillary action, impair the free supply of oil. Acids, properly applied, will precipitate the mucilage ; but long subsidence, or tedious filtration, are necessary for this purpose ; and after all, the oil is found still to retain some acid, or at least its properties have undergone some change, which diminishes its inflammability.

Linseed oil is not made use of in lamps, but there is an immense consumption of it, as the basis of oil paints, both of those that are used in house-painting within doors, and of those that are employed by the artist. Linseed contains so much mucilage, that it is necessary to roast the seed, more or less, in order to enable it to give out its oil to the action of the press ; and on this account the oil, which naturally has only a pale yellow colour, is generally reddish brown, from the previous roasting of the seeds, and still contains also a considerable proportion of mucilage. By separating from the oil this scorched mucilage, it is much improved as a vehicle for white and pale colours, and is also better able to resist the action of air and weather.

M. Thénard was, it appears, the first who published a method of freeing seed oils from their mucilage, by the action of sulphuric acid ; but the subsequent separation of the charred matter, by long standing, or by slow filtration, was a great objection to the process ; and the attempt to wash out the remains of the acid, by mechanical agitation of the oil with water, either cold or warm, was far from being fully successful.

Mr. Cogan's process, though resembling M. Thénard's in the first part of it, is completed by the judicious introduction of steam ; by means of which the oil appears to be almost entirely freed from acid, and the black feculent dregs subside in the course of twelve hours, leaving the supernatant oil quite clear, and greatly improved in colour, and in those qualities for which it is valued by the painter.

The quantity that he operates at, once is about 100 gallons. For this, three quarts, that is about ten pounds of sulphuric acid (oil of vitriol) is required. The acid is to be diluted with an equal bulk of water. The oil being put into a copper pan, of the shape of a boiler, two quarts of the dilute acid are to be added; the whole is then stirred up very carefully for an hour or more with a wooden scoop, till the acid has become completely incorporated with the oil, and the colour of this last has become much deeper than at first. A second similar quantity of acid is then to be added, and mixed with the oil in the same way as the first was; and after this, the remaining third part is to be added. The stirring of the oil is to continue incessantly for about six hours in the whole, at the end of which time the colour of the mixture will be almost that of tar. It is then to be allowed to stand quiet for a night, and in the morning is to be transferred to the boiler; this is of copper, and has a steam-pipe entering it at the bottom, and then dividing into three or four branches, each of which terminates in a perforated plate. The steam, thus thrown in, passes in a very divided state into the oil, penetrates into every part of it, and heats it to the temperature of boiling water. The steaming process is to be continued for about six or seven hours, when the oil, &c. is to be transferred to a cooler, of the form of an inverted cone, terminating in a short pipe, commanded by a stop-cock inserted in its side, a few inches from the bottom. After remaining a night in the cooler, the oil is fit to be withdrawn; for this purpose the cock at the bottom is opened, and the black watery acid liquor flows out. As soon as the oil begins to come, the cock is closed, and that in the side of the cooler is opened. From this the oil runs quite clear and limpid, the whole of that which is still turbid remaining below the upper cock. The purified oil being drawn out, that which is turbid is let out into a reservoir, where it either remains to clarify by subsidence, or is mixed with the next portion of raw oil.

**LXI.—On British Leghorn Plat for Hats and Bonnets,  
By Lady HARRIET BERNARD\*.**

HER Ladyship, in a letter to A. Aikin, Esq., secretary to the Society for the Encouragement of Arts, Manufactures, and Commerce, Adelphi, dated Castle Bernard, Ireland, Oct. 19, 1827, states that she has made some improvement in the mode of preparing the rye-straw, which is the material for plat employed in the school under her ladyship's patronage. The rye, instead of being pulled while the stalk is yet green, and the grain milky, is now allowed to grow till the grain is within about ten days of being ripe; by which means a more glossy and better coloured straw is obtained. The process of scalding is replaced by simply drying in the air and sun, by which the gloss remains uninjured, and the hats and bonnets made of straw, look really like new ones; whereas they but too often acquire by scalding the appearance of old hats, after they have been washed or cleaned. Straw nearly ripe is much more expeditiously bleached by the sun than when cut green; a circumstance of no small importance to the Irish manufacturer.

\* From the same work as the last article.

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**LXII.—On the so termed, Chinese Rice Paper\*.**

THIS article is imported into this country in considerable quantity, and is employed as a material for artificial flowers, and for other ornamental purposes. Its common name shows the popular opinion respecting its origin. The subjoined extract from a letter by John Reeves, Esq. of Canton, a member of the Society of Arts, proves, however, that the rice paper is not a manufactured article, but an unchanged vegetable production, cut spirally, and afterwards flattened by pressure.

\* From Vol. XLVI. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

SIR,

Canton, March 7, 1826.

My son will soon forward to you a sheet of the substance, called in England "rice paper," and the piece of the plant (or I should rather say, of the branch of the plant) from which it is made; but whether this is a tree or shrub I cannot at present discover, as the person from whom I had my information, had only seen the mode of cutting and using the plant.

The branches being cut into lengths of the intended, or usual breadth of the sheet of rice paper, are placed upon a thick piece of copper, with two raised edges, as guides to keep them steady; and being held in the left hand, are presented to the edge of a large knife, about ten inches long, and three inches broad, made very sharp, and held in the right hand.

A slight incision being made in the piece of branch for its whole length, it is kept moving round by the left hand, while the knife is also kept in motion by the right hand, and is thus sliced or pared down from circumference to centre, and then spread out to flatten.

The sheets are usually made up into bundles, of nineteen or twenty pieces each, which weigh about twenty-three ounces; and are sold wholesale, for about one dollar a bundle.

The refuse pieces, such as that sent you, are used for making artificial flowers.

It is chiefly brought from the island of Formosa, by the Chinese junks; hence is the difficulty of ascertaining the nature of the plant; as few if any of the persons concerned in the sale of the prepared article at Canton, have ever seen from what it is made.

I am, Sir, &amp;c. &amp;c.

To A. AIRIN, Esq. Secretary, &amp;c. &amp;c.

J. REEVES.

*Remarks by the EDITOR.*

We have long been of opinion, from microscopic observations, that the so termed "*Chinese rice paper*," was an organized vegetable production, much resembling in its

structure *the pith of elder*; and our opinion is now fully confirmed by Mr. Reeves's letter.

It appears to us, that the two raised edges upon the sides of the piece of copper, serve not only as guides to keep the pith steady, but also to *regulate the thickness of the slices*; the knife lying upon their tops, and the piece of pith being held down upon the bottom of the plate of copper, and gradually turned round and presented to the edge of the knife, whilst it is carried along backwards and forwards; the slice cut will pass underneath the knife, and escape at the front of the plate, and be succeeded in its turn by the remainder of the slice, until the operation is finished.

We have no doubt that cylindrical pieces, either of elder or other pith, might be found in this country, quite large enough to bear slicing in this manner; and which slices, after being flattened by pressure between plates (possibly warmed or heated) might serve as substitutes for the Chinese ones; and be equally capable of receiving any colours as they are. We now see beautiful figures cut out of elder pith, by a skilful hand, exposed for sale in most of our philosophical instrument maker's shops, for electrical experiments; and hope soon to see leaves of it formed in the same manner.

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## LIST OF PATENTS FOR NEW INVENTIONS,

*Which have passed the Great Seal since April 23, 1829.*

To Benjamin Cook, of Birmingham, in the county of Warwick, brass founder; for an improved method of making rollers or cylinders of copper, and other metals, or a mixture of metals, for printing of calicoes, silks, cloths, and other articles. Dated April 23, 1829.—To be specified in six months.

To James Wright, of Newcastle-upon-Tyne, soap maker; for improvements in condensing the gas or gases produced by the decomposition of muriate of soda, and certain other substances, which

improvements may also be applied to other purposes. Dated April 28, 1829.—In six months.

To Peter Pickering, of Frodsham, in the county of Chester, but now domiciliated in Dantzic, in Prussia; and William Pickering, of Liverpool, in the county of Lancaster, merchants; for an engine or machinery, to be worked by means of fluids, gases, or air, on shore or at sea, and which they mean to denominate Pickerings' Engine. Dated April 28, 1829.—In six months.

To John Davis, of Lemon-street, in the county of Middlesex, sugar refiner; who, in consequence of a communication made to him by a foreigner residing abroad, is in possession of a certain improvement in the condenser, used with the said petitioner's apparatus, for boiling sugar in vacuo, for which a patent was granted to him the 29th day of March, 1828, entitled an improvement in boiling or evaporating solutions of sugar and other liquids. Dated April 28, 1829.—In six months.

To Henry Robinson Palmer, of the London Docks, in the county of Middlesex, civil engineer; for a certain improvement or improvements in the construction of warehouses, sheds, and other buildings intended for the protection of property. Dated April 28, 1829.—In two months.

To George William Lee, of Bagno Court, Newgate-street, in the city of London, merchant; who, in consequence of a communication made to him, by a certain foreigner residing abroad, is in possession of certain improvements in machinery, for spinning cotton and other fibrous substances. Dated May 2, 1829.—In six months.

To Henry Bock, of Ludgate-hill, in the city of London, Esq. who, in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of improvements on machinery and apparatus for embroidering or ornamenting cloths, stuffs, and other fabrics. Dated May 2, 1829.—In six months.

To James Dutton, junior, of Wotton-Underedge, in the county of Gloucester, clothier; for certain improvements for propelling ships, boats, and other vessels, or floating bodies, by steam or other power. Dated May 19, 1829.—In six months.

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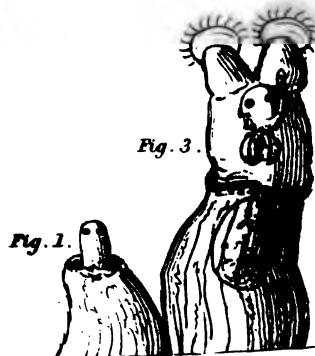
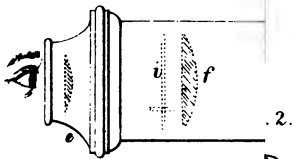
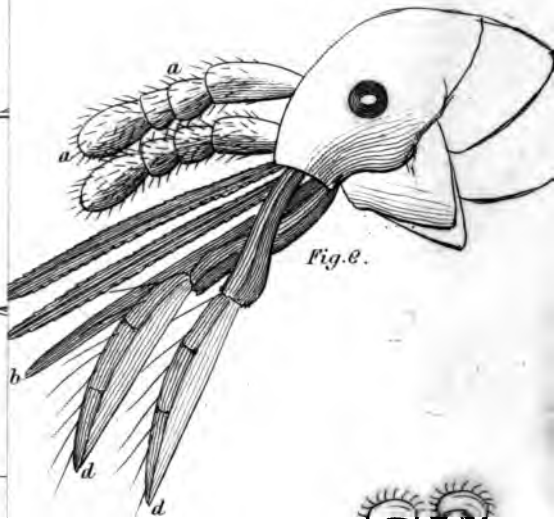
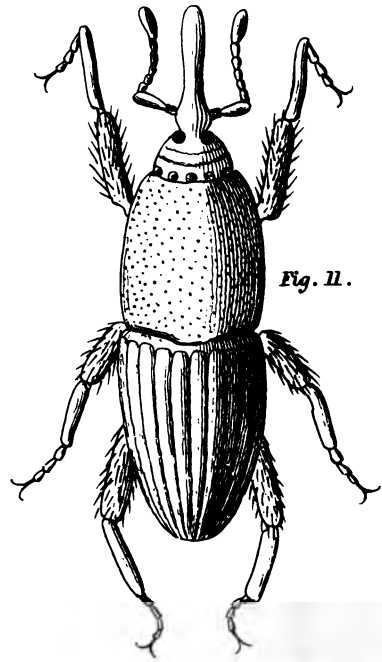
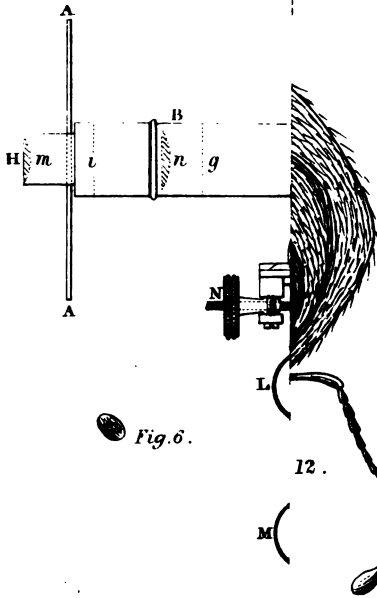
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1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is crucial for ensuring transparency and accountability in the organization's operations.

2. The second part outlines the various methods and tools used to collect and analyze data. It mentions the use of surveys, interviews, and focus groups to gather information from stakeholders. Additionally, it discusses the application of statistical analysis to interpret the collected data.

3. The third part describes the process of identifying and addressing the needs and concerns of different groups within the organization. It highlights the importance of active listening and communication in this process.

4. The fourth part discusses the implementation of strategies and initiatives designed to improve the organization's performance and achieve its goals. It mentions the role of leadership in driving these changes and the importance of monitoring progress.

5. The fifth part discusses the importance of evaluating the effectiveness of the implemented strategies and making necessary adjustments. It mentions the use of key performance indicators (KPIs) to measure success.

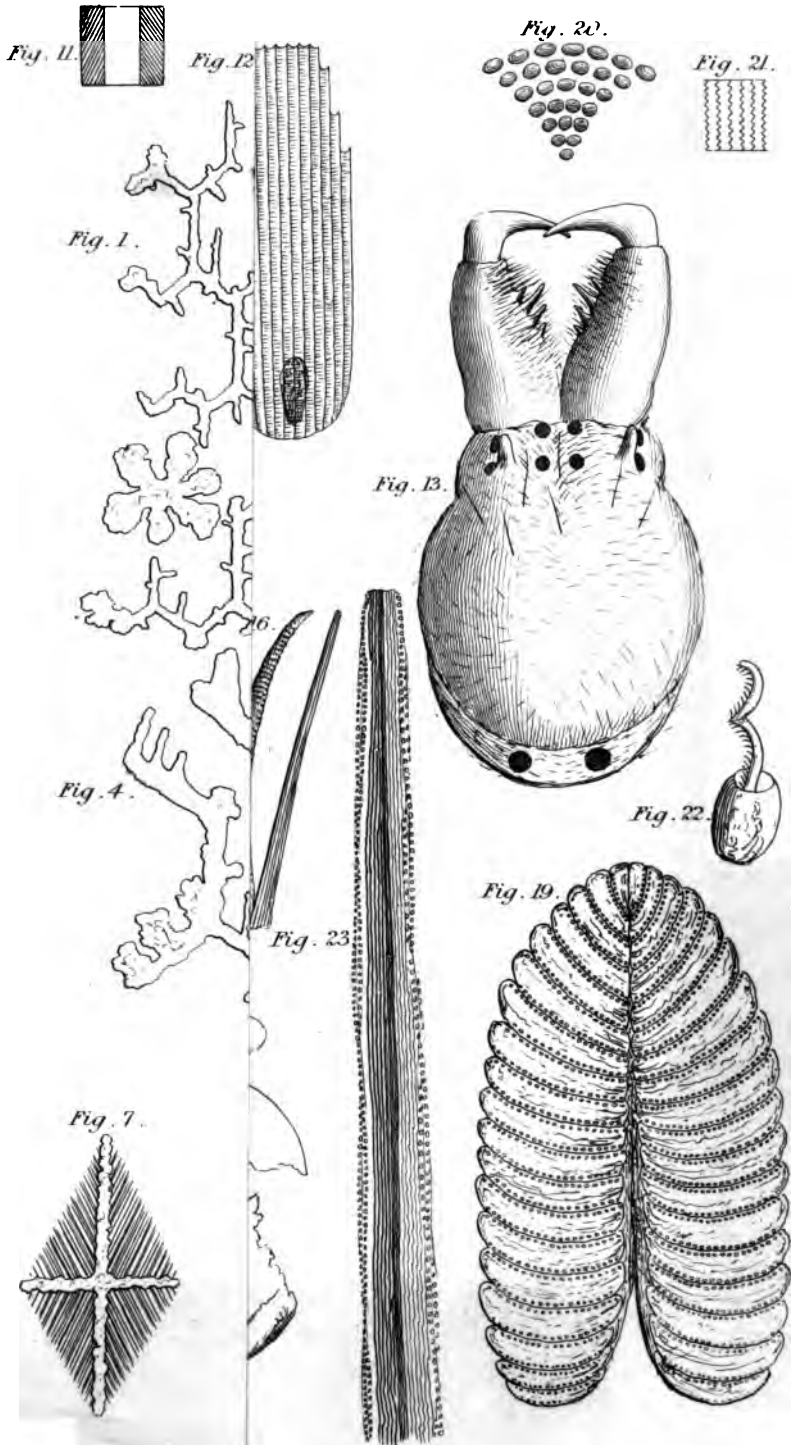
6. The sixth part discusses the importance of fostering a culture of continuous improvement and innovation within the organization. It mentions the role of training and development in achieving this.

7. The seventh part discusses the importance of maintaining strong relationships with external stakeholders, such as customers, suppliers, and the community. It mentions the role of marketing and public relations in this.

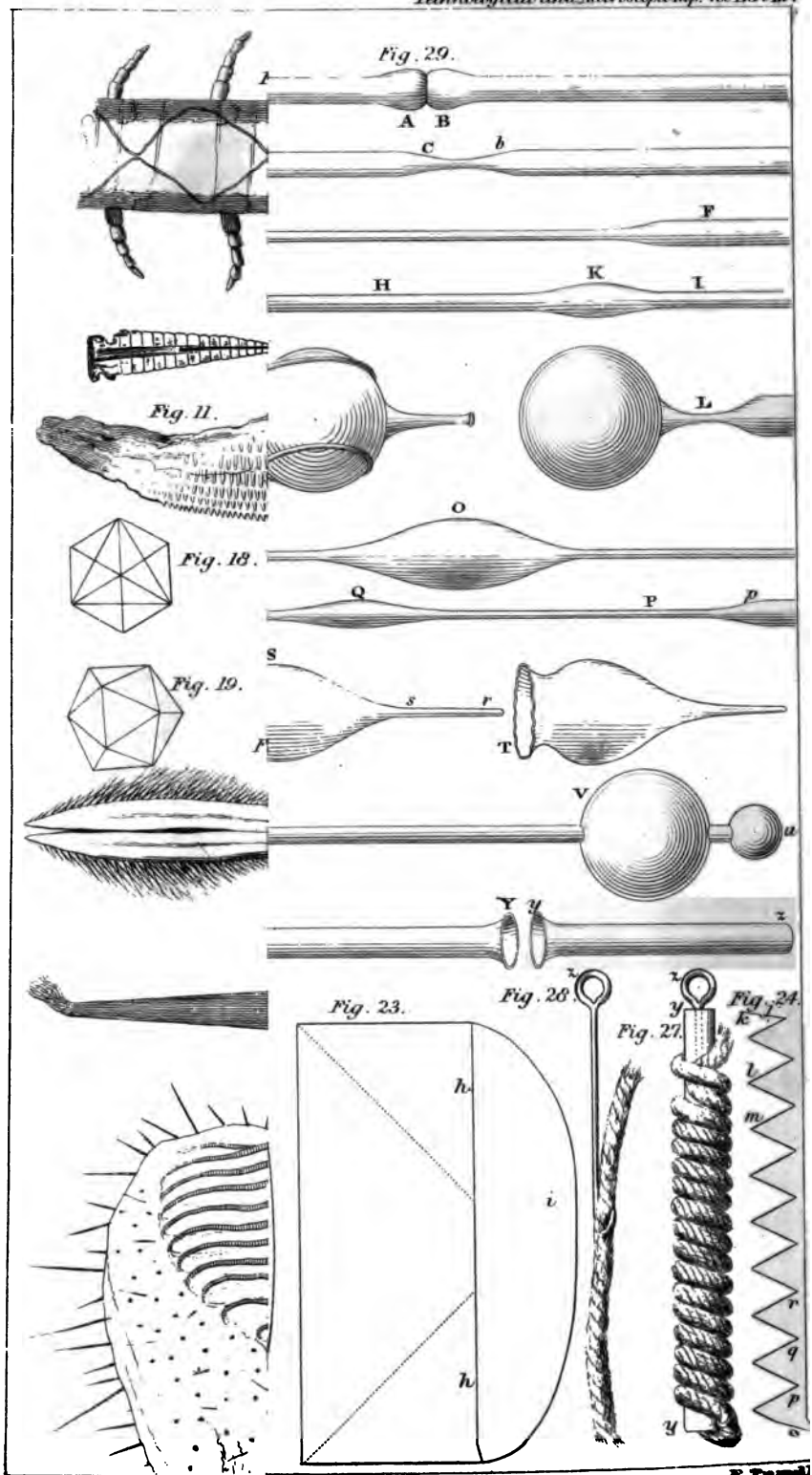
8. The eighth part discusses the importance of ensuring the organization's financial health and sustainability. It mentions the role of budgeting and financial management in this.

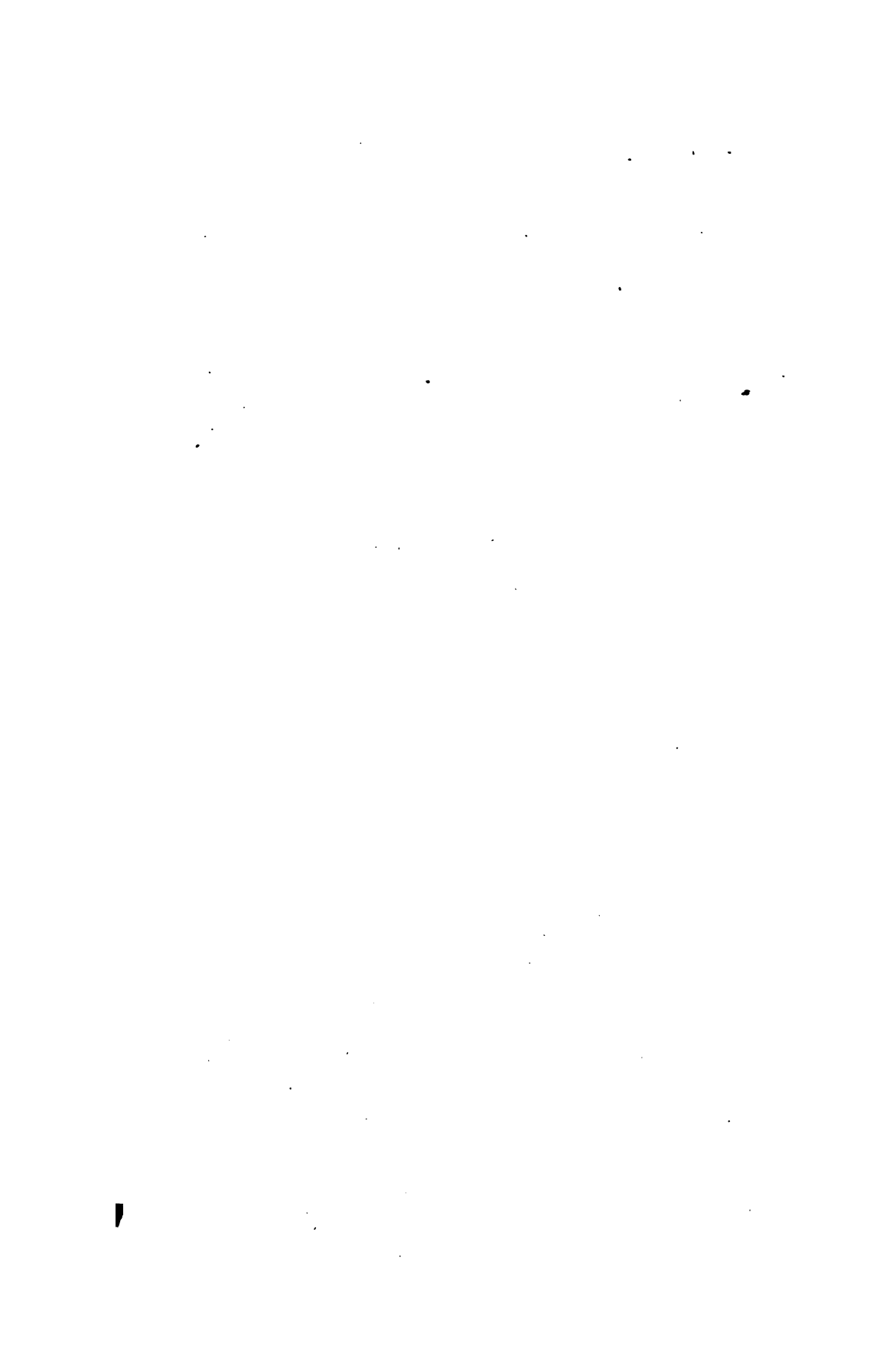
9. The ninth part discusses the importance of ensuring the organization's compliance with relevant laws and regulations. It mentions the role of legal and ethics departments in this.

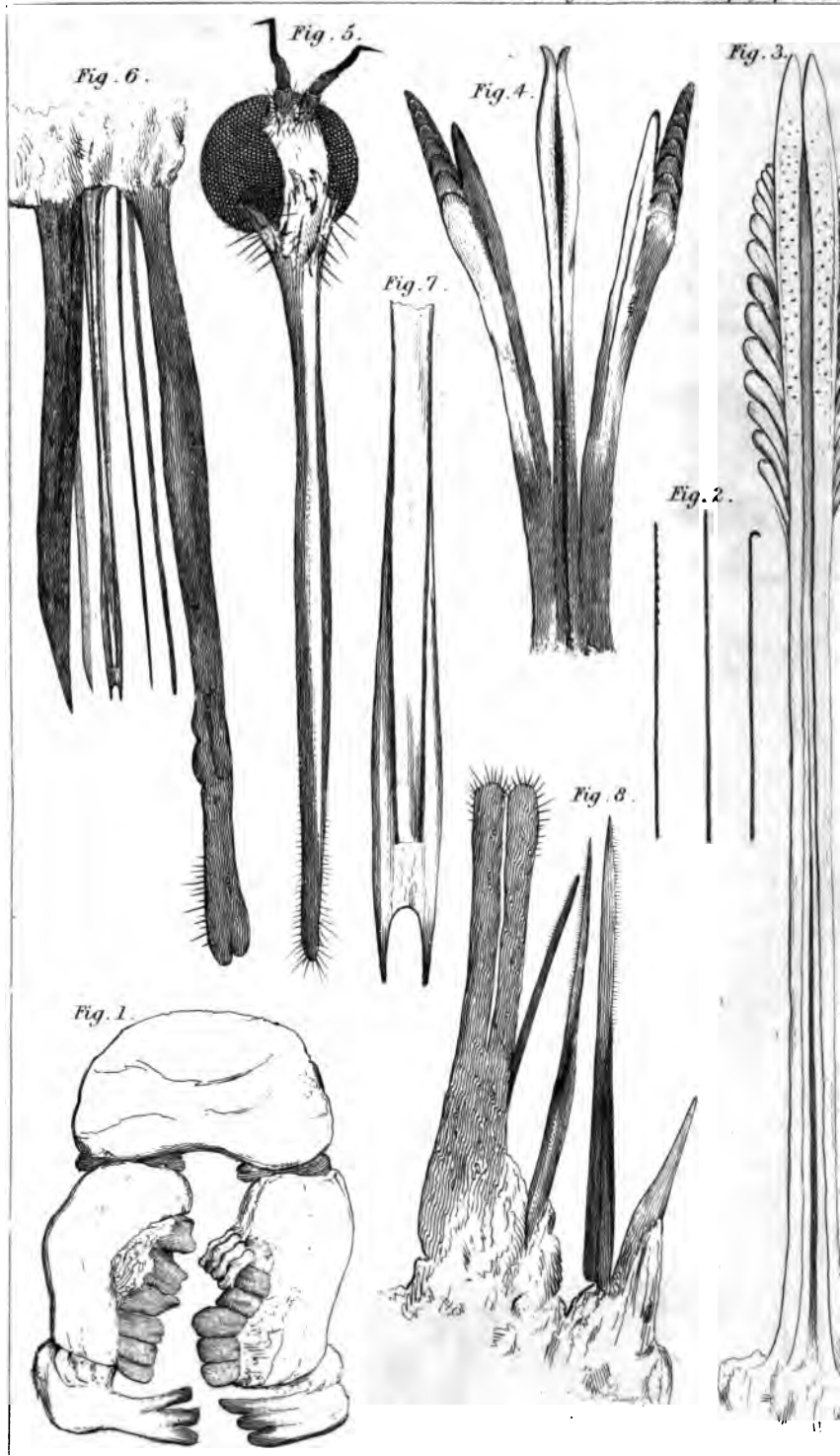
10. The tenth part discusses the importance of ensuring the organization's overall success and long-term viability. It mentions the role of all employees in achieving this.

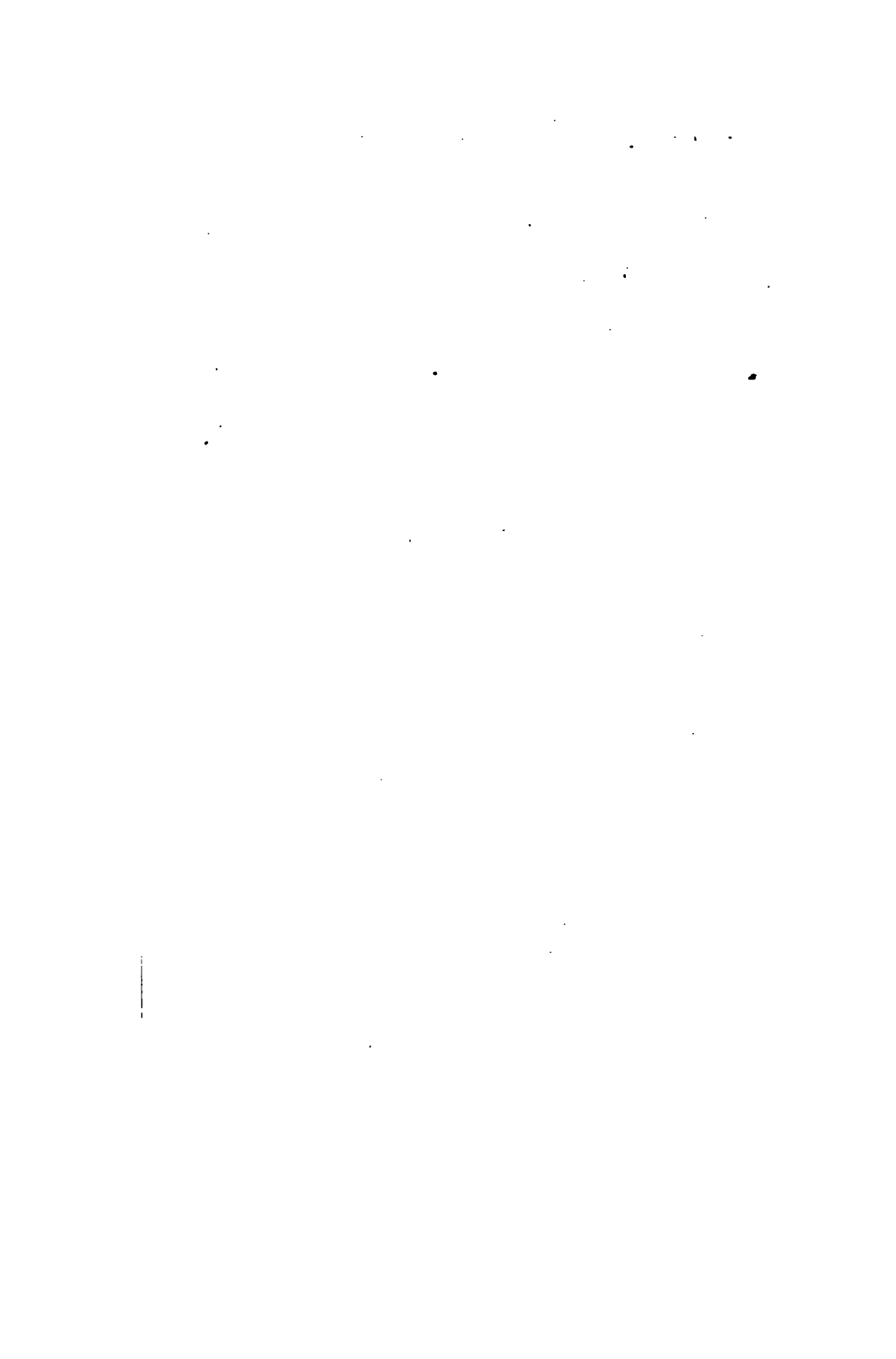


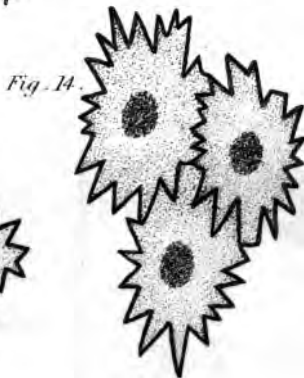
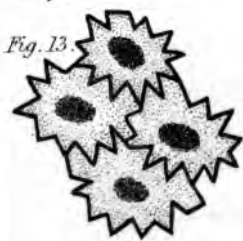
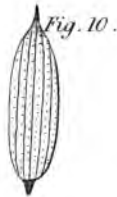
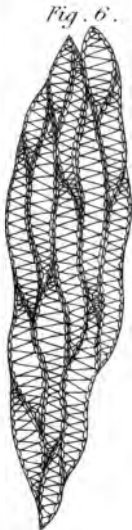
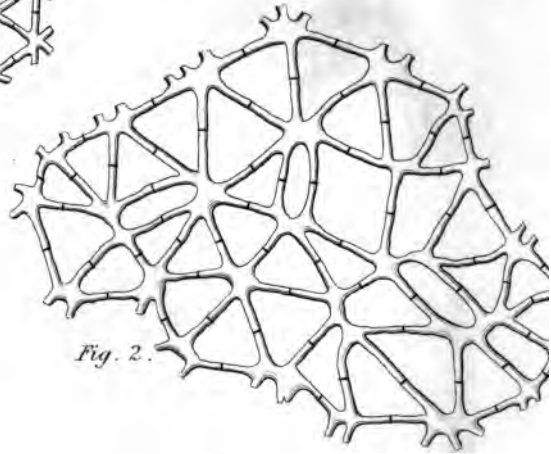
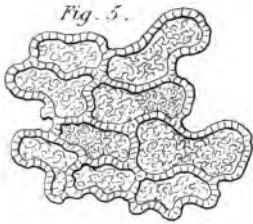
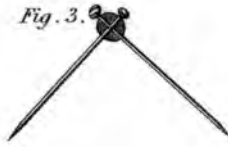
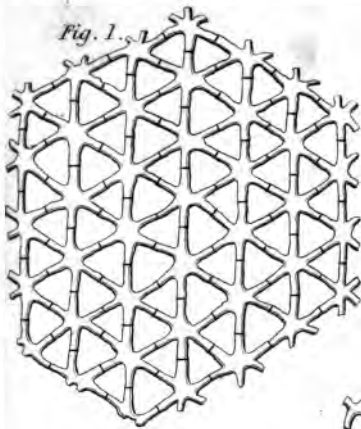




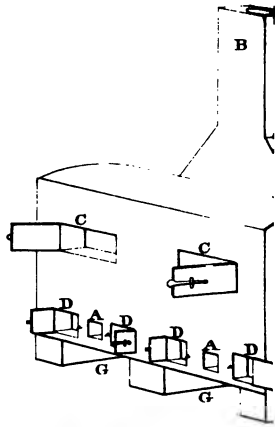




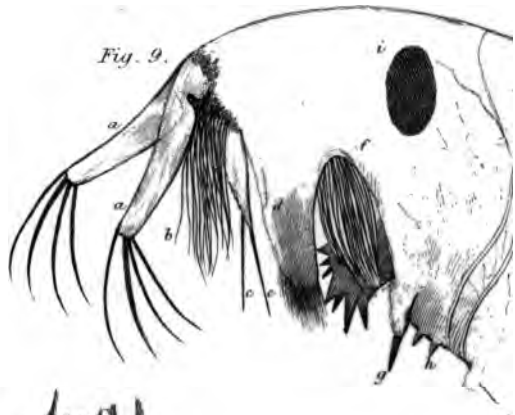
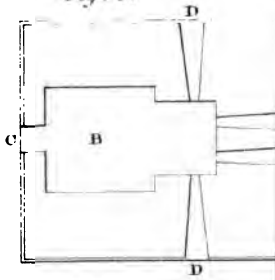








*Fig. 6.*



*Fig. 9.*

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*Fig. 8.*

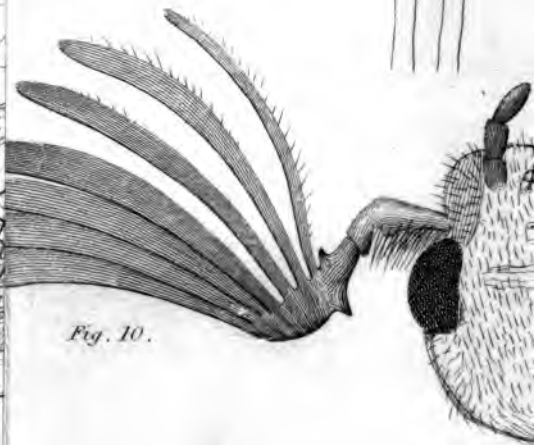
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*Fig.*



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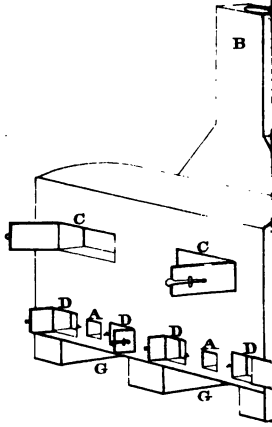
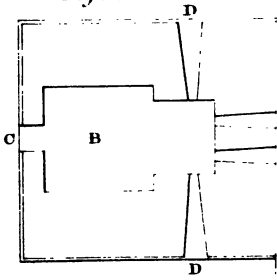


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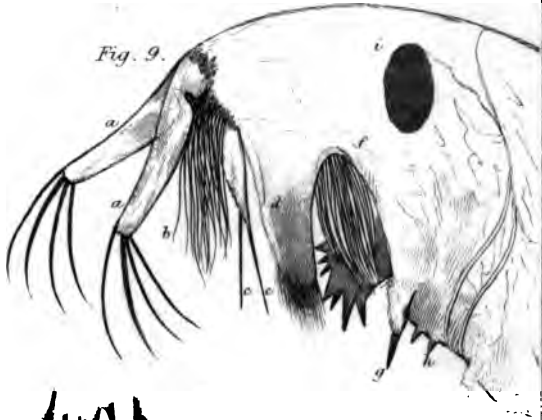


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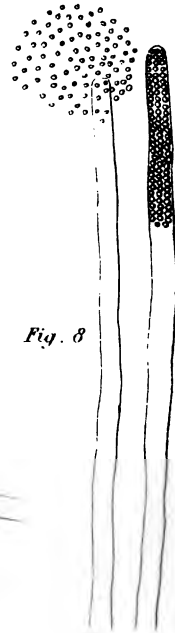


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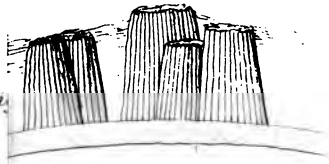


Fig.



Fig. 10.

